Aviation Week and Space Technology

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A McGraw-Hill Publication

March 20, 1961

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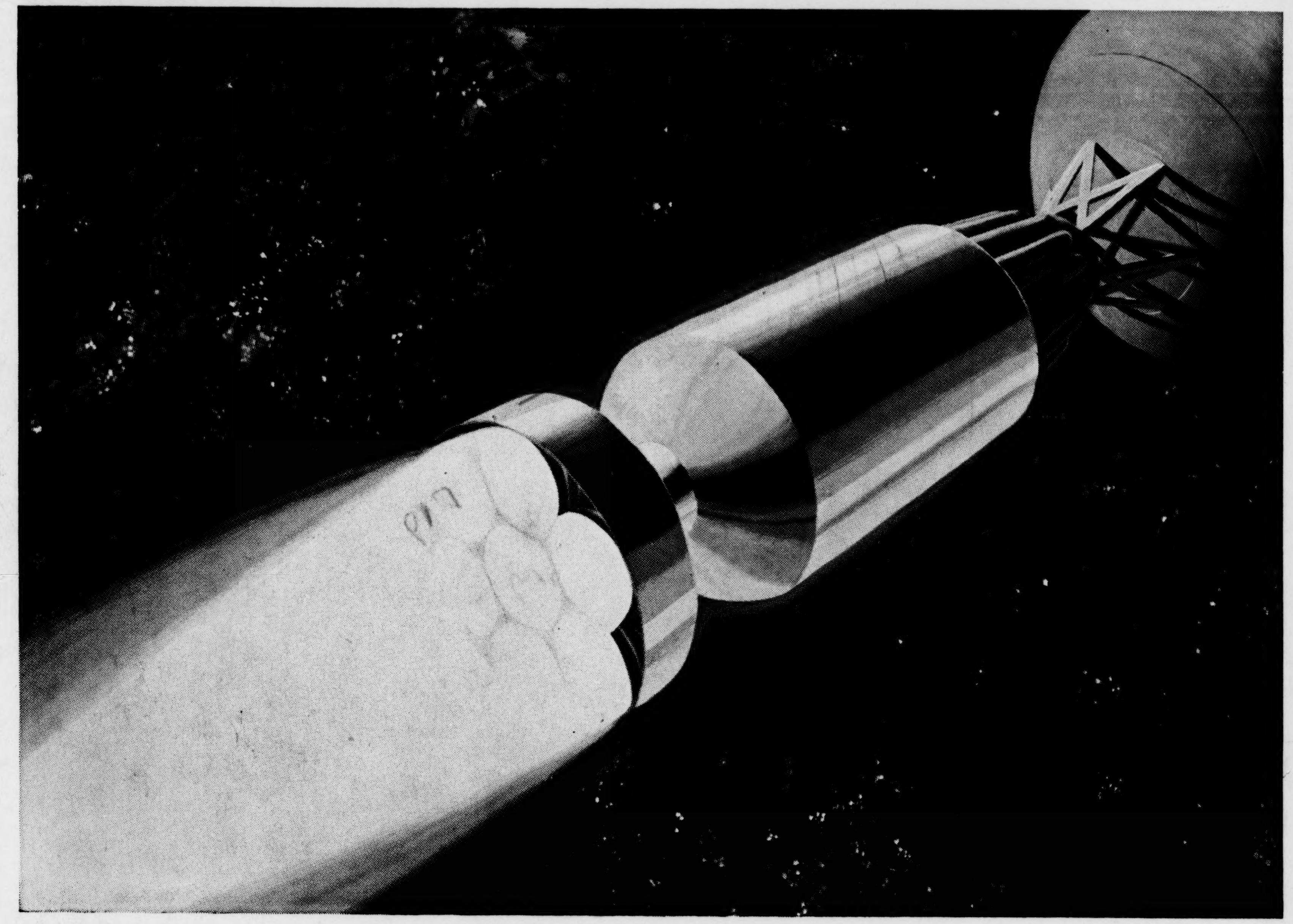
Fiat 7002 Helicopter

urbofans Improve Boeing 720B Performance

NUCLEAR ROCKET PROPULSION AT AEROJET-GENERAL



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AVIATION CALENDAR

Mar. 27-31—1961 Symposium on Temperature, Its Measurement and Control in Science and Industry, Columbus, Ohio.

Mar. 28-29—Nucleonics in Flight Symposium, American Nuclear Society, Statler-Hilton Hotel, Dallas, Tex.

Apr. 4-5—Aviation Technician School Administrators Conference, Purdue University, Lafayette, Ind.

Apr. 4-6—International Symposium on Electromagnetics and Fluid Dynamics of Gaseous Plasma, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Apr. 4-6—Lifting Re-entry Vehicles: Structures, Materials & Design, American Rocket Society, Palm Springs, Calif.

Apr. 4-7—National Aeronautic Meeting, Society of Automotive Engineers, Commodore Hotel, New York, N. Y.

Apr. 5-7—Annual Technical Meeting and Equipment Exposition, Institute of Environmental Sciences, Park Sheraton Hotel, Washington, D. C.

Apr. 10-11—Spring Meeting, Western States Section/The Combustion Institute, Aeronutronic Division of Ford Motor Co., Newport Beach, Calif.

Apr. 10-14—International Symposium on Aviation Research and Development, Federal Aviation Agency, Atlantic City.

Apr. 11-13—Conference on the Ultrapurification of Semiconductor Materials, Air Force Cambridge Research Laboratories, Boston, Mass.

Apr. 12-13—15th Annual Spring Technical Conference, Institute of Radio Engineers/American Rocket Society, Hotel Alms, Cincinnati, Ohio.

Apr. 13-14—Annual Meeting, National Aero-

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AVIATION WEEK and Space Technology

March 20, 1961
Vol. 74, No. 12

Published weekly with an additional issue in December by McGraw-Hill Publishing Company, James H. McGraw (1860-1948), Founder. See panel below for directions regarding subscription or change of address. **Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Printed at Albany N. Y. OFFICERS OF THE PUBLICATIONS DIVISION: Nelson L. Bond, President; Shelton Fisher. Wallace F. Traendly, Senior Vice Presidents; John R. Callaham, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator. OFFICERS OF THE CORPORATION: Donald C. McGraw, President; Joseph A. Gerardi, Hugh J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Keith Goodrich, Vice President and Treasurer; John J. Cooke, Secretary.

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Single copies 75¢. Subscription rates—United States and possessions, $7 one year. Canada $8 one year. All other countries, $20 one year.

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Second class postage paid at Albany 1, N. Y. Printed in U. S. A. Title registered in U. S. Patent Office.

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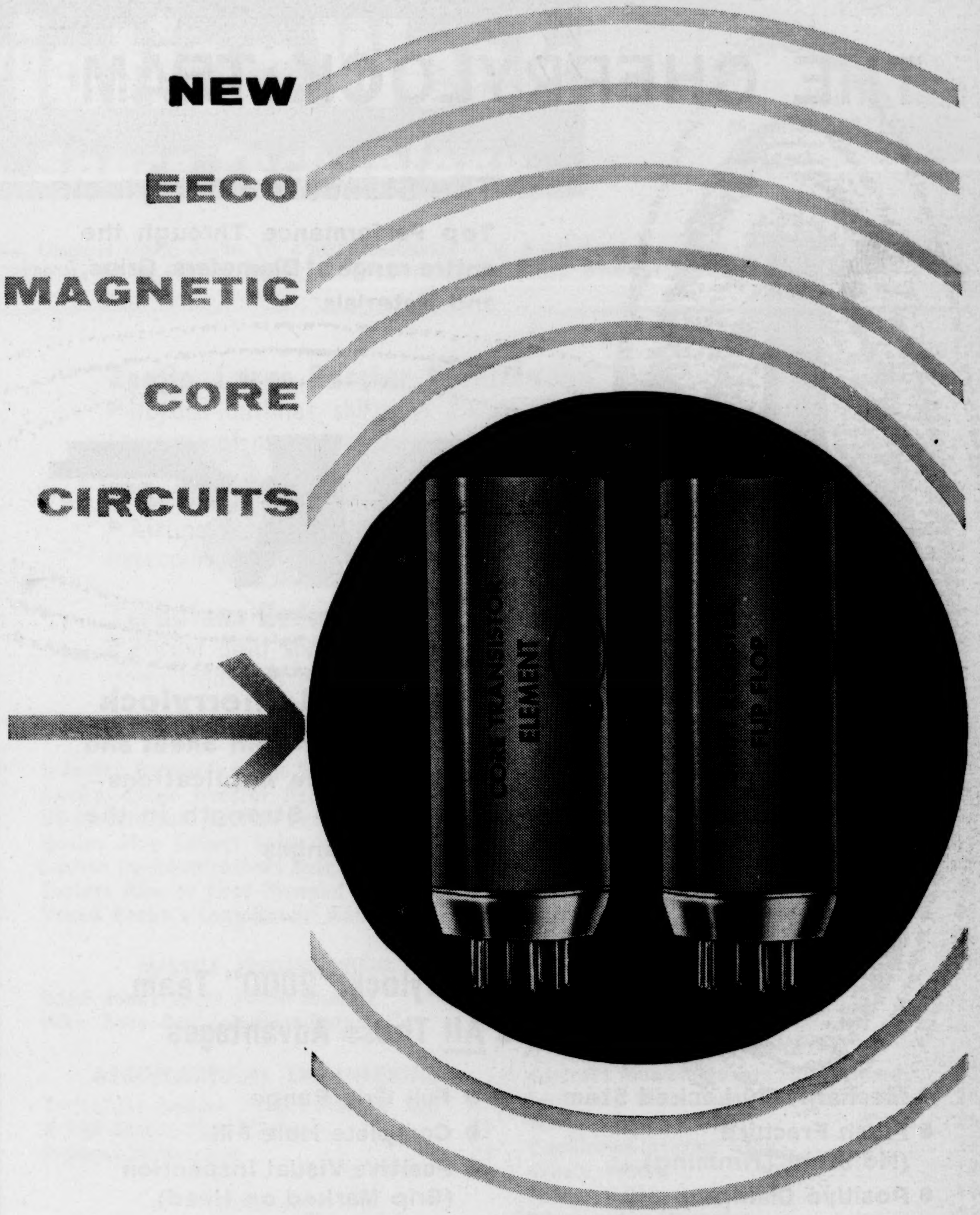

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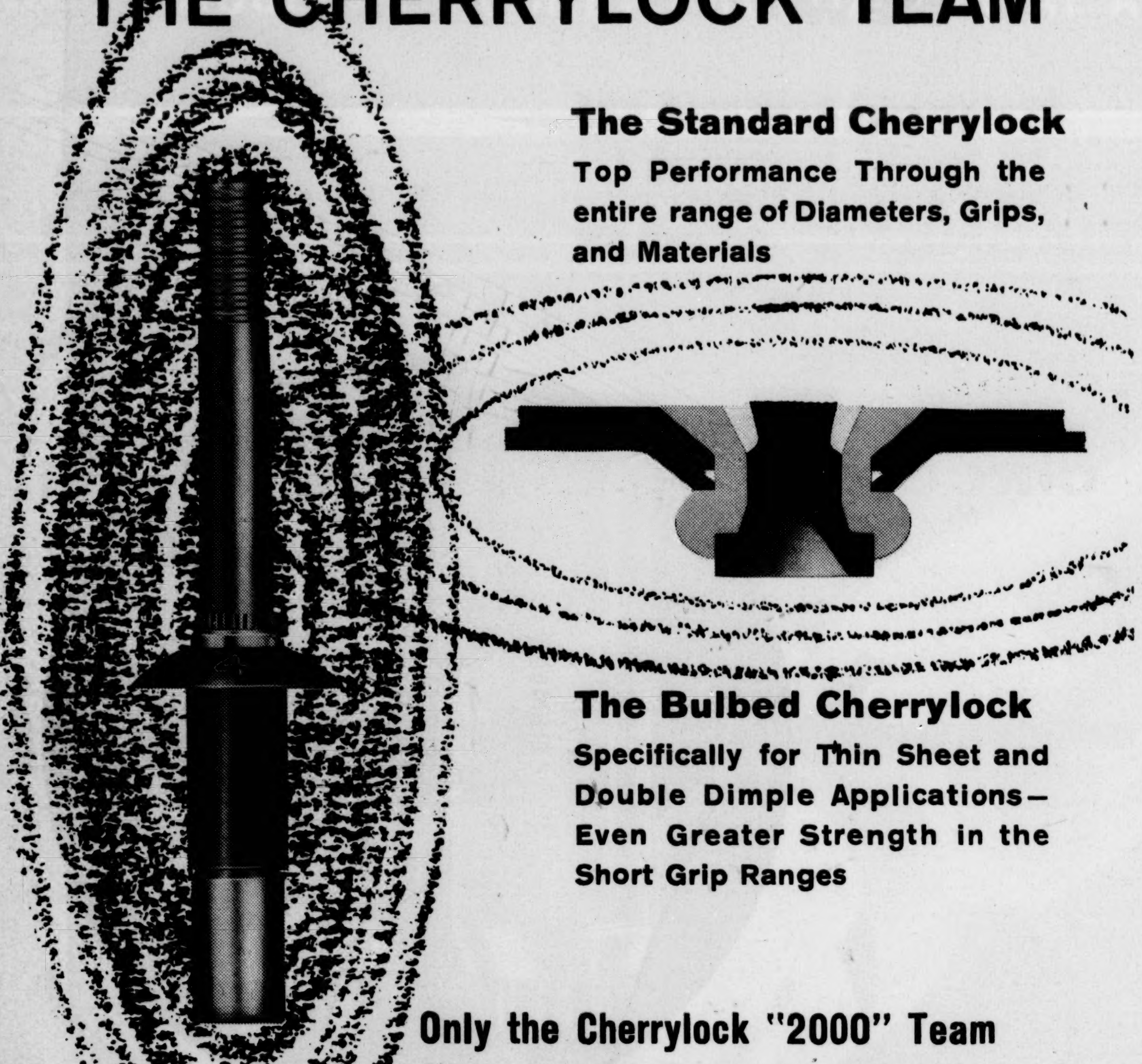

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AVIATION CALENDAR

(*Continued from page 5*)

nautical Services Assn., Hotel Washington, Washington, D. C.

Apr. 13-14—Institute of the Aerospace Sciences/Army Aviation Meeting (classified), Washington, D. C.

Apr. 17-28—14th Technical Conference, International Air Transport Assn., Queen Elizabeth Hotel, Montreal, Canada.

Apr. 18-20—Symposium on Chemical Reactions in the Lower and Upper Atmosphere, Stanford Research Institute, Mark Hopkins Hotel, San Francisco, Calif.

Apr. 20—Eastern Regional Meeting, Institute of Navigation, Shoreham Hotel, Washington, D. C.

Apr. 20-22—General Meeting, American Meteorological Society with the American Geophysical Union, Washington, D. C.

Apr. 22-25—Annual Meeting and Conference, American Assn. of Airport Executives, Broadmoor Hotel, Colorado Springs.

Apr. 24-27—32nd Meeting, Aerospace Medical Assn., Palmer House, Chicago.

Apr. 26-27—High Temperature Materials Conference, American Institute of Mining, Metallurgical and Petroleum Engineers, Pick-Carter Hotel, Cleveland, Ohio.

Apr. 26-28—Liquid Rockets, Propellants and Combustion Conference, American Rocket Society, Palm Beach Biltmore, Palm Beach, Fla.

Apr. 30-May 4—Seventh National Aerospace Instrumentation Symposium, Instrument Society of America, Adolphus Hotel, Houston, Tex.

May 2-4—Electronic Components Conference, Institute of Radio Engineers, Jack Tarr Hotel, San Francisco, Calif.

May 3-5—17th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

May 3-5—Nuclear Applications in Space Conference, American Rocket Society/Oak Ridge National Laboratory, Gatlinburg, Tenn.

May 8-10—National Aerospace Electronics Conference, IRE, Miami and Biltmore Hotels, Dayton, Ohio.

May 8-12—Annual Meeting, Airport Operators Council, Carillon Hotel, Miami Beach, Fla. (AOC-American Society of Civil Engineers' Joint Seminar, "Increased Capacity of Airport Systems," May 11-12.)

May 9-11—Western Joint Computer Conference and Exhibit, Ambassador Hotel, Los Angeles, Calif.

May 15-17—National Symposium on Microwave Theory and Techniques, IRE, Sheraton Park Hotel, Washington, D. C.

May 15-18—20th Annual National Conference, Society of Aeronautical Weight Engineers, Sheraton Hotel, Akron, Ohio.

May 22-24—National Telemetering Conference, Sheraton-Towers Hotel, Chicago, Ill.

May 22-24—Fifth National Symposium on Global Communications, Institute of Radio Engineers, Hotel Sherman, Chicago.

May 26-June 4—24th French International Air Show, Le Bourget, Paris, France.

July 25-Aug. 10—International Trade Fair and Aviation Exhibition, McCormick Place Exposition Center, Chicago, Ill.

Sept. 4-10—1961 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

March 20, 1961

Aviation Week and Space Technology

Vol. 74, No. 12
Member ABP and ABC

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COVER: Fiat 7002 cold tipjet helicopter is shown during initial flight evaluations conducted at Turin Airport, Italy. Helicopter is powered by a Fiat 4700 gas generator which provides 530 hp. at takeoff, delivering 7.5 lb./sec. of air to the blade tips. Aircraft has a gross weight of 3,080 lb. and carries a useful load of 1,760 lb. (AW Jan. 25, 1960, p. 112). Tail rotor is driven from the main rotor. Fiat plans both military and civil applications for the 7002.

PICTURE CREDITS
Cover—Fiat; 29, 67, 69, 71—Boeing; 30—Convair; 35—Sud Caravelle; 50 (top)—Douglas Aircraft, (bottom) Rocketdyne; 51—United Technology Corp., Pratt & Whitney; 72—Lockheed; 79, 81—USAF; 84—Perkin-Elmer; 96—Morane-Saulnier.

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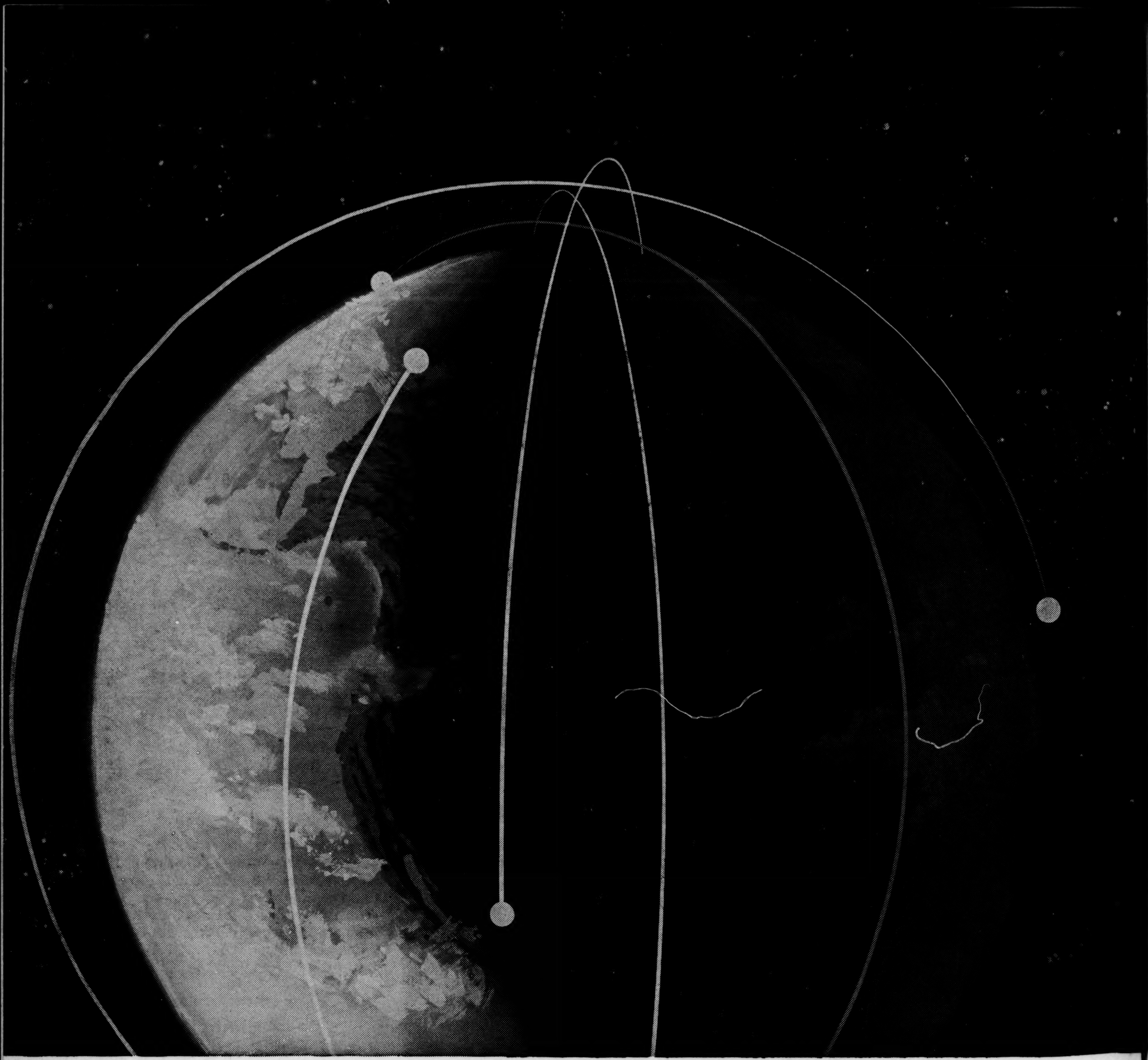

Midas satellites: our infrared eyes in space

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LOCKHEED

MISSILES & SPACE DIVISION, SUNNYVALE, CALIFORNIA

EDITORIAL

New Space Power Program Needed

For several years, we have listened with increasing anger to a fatuous party line dispensed by the top technical spokesmen of the government to gloss over the critical significance of the widening gap between U.S. and Russian rocket engine power. This thesis, chanted with regularity by such spokesmen as Neil McElroy, Herbert York, George Kistiakowsky and Keith Glennan, maintained that the Soviet rocket superiority had little technical significance because we had "just enough thrust" to hurl the warheads of early-model Atlas ICBMs over the simplest ballistic trajectory between U.S. bases and Soviet targets.

This explanation was used to explain their persistent veto of any attempts by the military and industry to develop significantly larger rocket engines, and also to generate an air of public complacency with the grossly inadequate space power development program they were sponsoring.

This program is aimed at creating a U.S. capability in 1965 which will duplicate what the Soviets are doing now.

The "just enough thrust" fallacy has no validity even in the ICBM area, where it was used most often to parry and blunt new powerplant proposals and to justify past errors. For the purpose of this polemic, we will ignore this aspect of the argument on how much thrust is in fact required in ICBMs for increased warhead yield, for use of multi-bomb warheads and for carrying decoys and using flight tactics that nullify defensive computer work based on the simplest ballistic trajectory between launch site and target.

Fallacy in Space

For it is in the area of space technology that this fallacy is bearing its most serious consequences and has condemned the United States to a space program far below its genuine technical capability, and far short of its competitive requirements. The most powerful boosters now being developed in the ICBM program are not sufficiently powerful to hurl the Dyna-Soar manned space vehicle into orbit. Nor can the Atlas ICBM engines now being used with the Samos space reconnaissance system launch all of the reconnaissance equipment desired in this orbital package. This system, along with others, will suffer greatly reduced military capability for some time due to the "just enough thrust" powerplants that satisfy Messrs. McElroy, York, Kistiakowsky and Glennan.

We were equally impatient with the ultra-conservative, tidily-budgeted original NASA booster program that was repeatedly defended by its sponsors before Congress and in public speeches with incredible complacency as a program that admittedly would only equal the current Soviet space payload capability some four or five years hence.

Thus, it was refreshing to listen to the industry spokesmen who recently appeared before the House Committee on Science and Astronautics (see p. 50 and AW Mar. 13, p. 303) with specific technical plans offering the hope of intercepting and surpassing Soviet capabilities in the same period when the old NASA program modestly aimed at equalling the 1960-61 Soviet performance. It is also encouraging to note the technically sound and critical approach to this glaring weakness in our national technology taken by the Wiesner report to President Kennedy (AW Jan. 23, p. 79) and the USAF Space Advisory Group headed by Trevor Gardner. Even more encouraging is the behind-the-scenes stirring within NASA and USAF to organize a new national rocket booster program aimed at fully exploiting the scientific and industrial resources available in this critical area.

Unrealized Technical Capability

The programs outlined to the House space committee, even allowing for the normal percentage of industry brochuremanship, showed clearly that the technical capabilities of this nation in space power development are far in excess of what the planners who have been running the national space program have recognized.

It should be evident now, both to Congress and to the executive branch of the government, that a basic new power development program, to meet both military and scientific requirements of space technology, is most urgently needed.

As the industry spokesmen before the House space committee emphasized, this program can serve no useful purpose if it is aimed at meeting yesterday's requirements tomorrow. It must be aimed at pushing the entire spectrum of space powerplant development to its full potential as fast as possible without waiting for specific requirements to appear in either military or civil space programs.

The powerplant has always been one of the longest lead time items in any weapon system development program. The policy of tying powerplant development to specific weapon systems has usually resulted in the eventual production of an underpowered vehicle. It is about time that this bitter lesson is learned thoroughly, and that the national space booster program sets its sights high enough so that when requirements for specific space vehicles emerge, they will find a full family of adequate powerplants coming along in the development cycle, ready for speedy application to their specific problems.

If the promised dynamics of the Kennedy Administration are to be translated into specific action that will establish an unquestionable hallmark of technical superiority for this country, a new national space power program offers an immediate and significant opportunity.

—Robert Hotz

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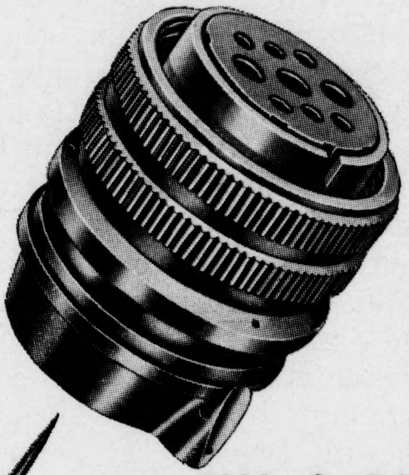

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POKE "R"
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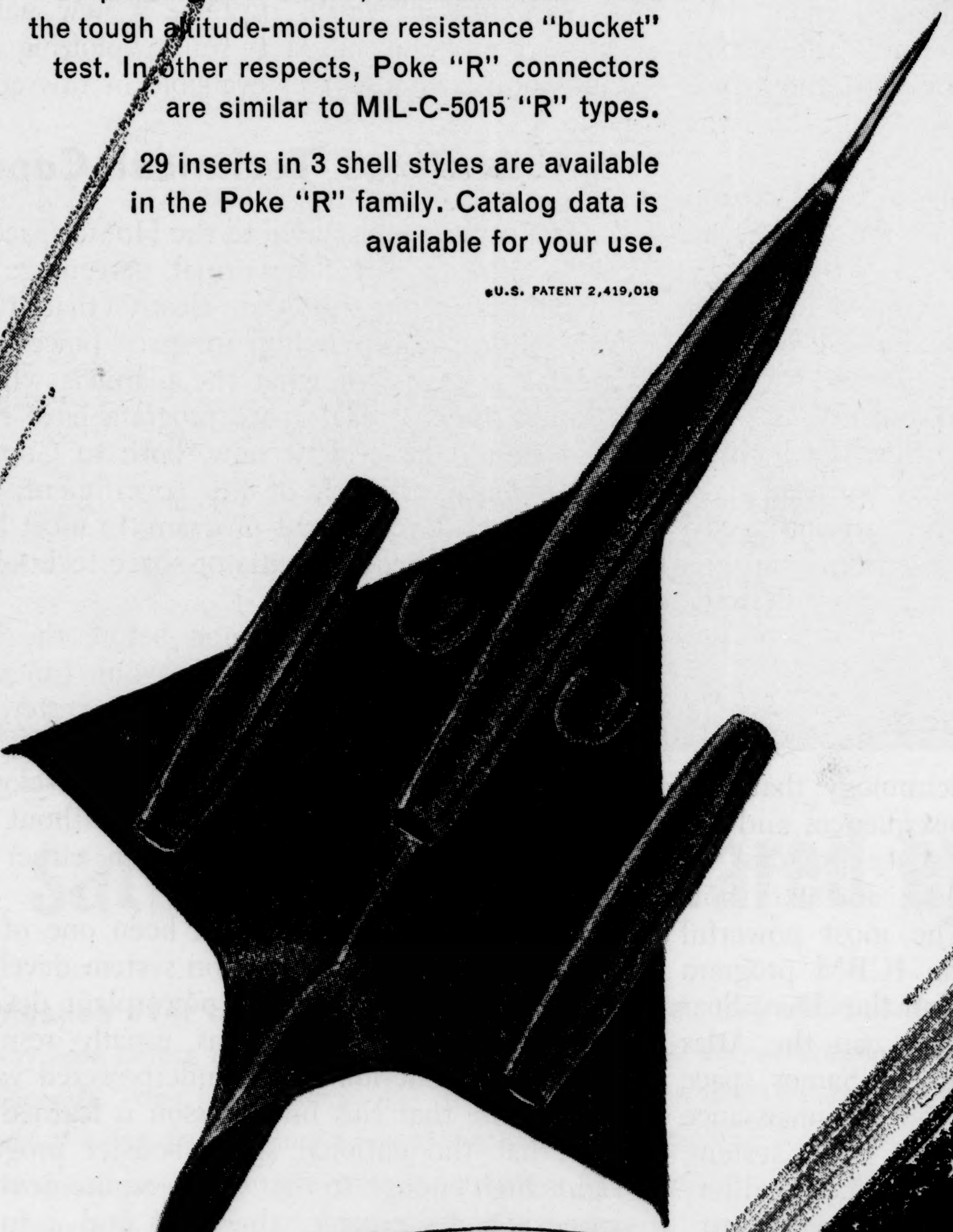

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In the Front Office

Harold J. Berry, a director of United Aircraft Corp., East Hartford, Conn., replacing **Joseph P. Ripley**, resigned. Mr. Berry is executive vice president and a director of Harriman Ripley & Co.

Richard M. Mock, a director of Digitronics Corp., Albertson, N. Y. Mr. Mock is chairman of the Executive Committee of Lear, Inc.

Wyle Laboratories, El Segundo, Calif., has elected the following four additional directors: **Harold E. Edgerton**, board chairman and vice president of Edgerton, Germeshausen & Grier, Inc.; **Richard W. Jones**, managing partner of Mitchum, Jones & Templeton; **Robert J. Garon**, vice president and general manager, and **Elmer R. Easton**, vice president-field engineering and contracts, Wyle Laboratories.

Nicholas Dykstra, a director of McDonnell Aircraft Corp., St. Louis, Mo. Mr. Dykstra is McDonnell's vice president-finance.

Ralph F. Gow, a director of Miniature Precision Bearings, Inc., Keene, N. H. Mr. Gow is president of Norton Co.

Leroy C. Bower and **Herbert A. Cohen**, directors of United Systems Corp., Washington, D. C. Mr. Bower is general manager of Technology Instrument Corporation of Acton, Mass. and Mr. Cohen is manager of TIC's Space Instrumentation Division.

Edward H. DaCosta, president of Taylor Fibre Co., Norristown, Pa., succeeding **John M. Taylor, Jr.**, now board chairman.

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John J. Roscia, a vice president and general counsel, North American Aviation, Inc., Los Angeles, Calif., and **Gerald B. Brophy**, senior counsel to the directors and the president on special matters.

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Dr. Maurice A. Meyer, vice president-Adcole Corp., Cambridge, Mass.

August Nuut, vice president-engineering for special products, American Missile Products Co., Inc., Los Angeles, Calif.

George B. Shaw, a vice president of ACF Industries, Inc. Mr. Shaw continues as general manager of the ACF Electronics Division, Riverdale, Md.

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Frank Nichol, executive vice president, Houston Fearless Corp., Los Angeles, Calif.

Herbert A. Finke, vice president and general manager, Bomac Laboratories, Inc., Beverly, Mass.

Camille M. Shaar, Jr., head of Aerospace Operations for the Defense Systems Divisions of General Motors Corp., Santa Barbara, Calif.

Col. Thomas W. Cooke, commander of Redstone Arsenal, Ala.

(*Continued on page 100*)

INDUSTRY OBSERVER

▶ Among techniques Air Force Ballistic Missile Division is considering for use in Project Vela control posts for detecting nuclear explosions in space are very low frequency pulses, visible light, backscatter from radar, cosmic noise and absorption and fluorescence in the atmosphere.

▶ Investigation of basic design requirements of a manned spacecraft capable of returning to earth after a soft lunar landing is planned by NASA's Marshall Space Flight Center. The analysis will stress weight, size and lunar launch thrust requirements.

▶ Third and fourth Tiros satellites will carry two wide-angle television cameras instead of the combination of a wide-angle and a narrow-angle camera in Tiros II. All other equipment will be the same as in Tiros II. NASA says the narrow-angle camera has been eliminated because meteorologists feel they can get more useful data with the two wide-angle systems.

▶ Convair-Ft. Worth will test the effects of nuclear radiation on four types of metal at −423F, approximately the temperature of stored liquid hydrogen which will be the working fluid for nuclear rocket propulsion systems. Two stainless steel alloys, a titanium alloy and an aluminum alloy will be used in the tests.

▶ Navy Bureau of Weapons is developing the Mark 46 anti-submarine torpedo to advance the speed limit to 500 kt. for air launching these weapons. Mark 46 is decelerated by a parachute, which detaches before the torpedo hits the water. Prototypes have been flight tested in drops over both water and land to check parachute performance and aerodynamic and hydrodynamic characteristics.

▶ Techniques for improving survivability of tactical strike aircraft, such as the Republic F-105, will be evaluated by Air Force in its analysis of penetration aid proposals submitted by about 15 companies in a competition for two study contracts.

▶ Raytheon will test diffraction angles and penetration abilities of various radio frequencies under Air Research and Development Command's Project Cozi, for communications zone indicator. Navy has been conducting similar tests in the very low frequency range with a piggy-back experiment attached to Transit IIIB.

▶ Bell Helicopter is negotiating with NASA for conversion of its XV-3 tilt-rotor VTOL/STOL testbed to turbine power, with the Lycoming T53 replacing the current Pratt & Whitney R985 piston engine. The turbine-powered XV-3 probably would provide NASA with research data for use in the tri-service VTOL program (AW Feb. 27, p. 33).

▶ Ballistic Missile Division is expected to choose a contractor sometime after April for outfitting three ships with optical and radar tracking equipment and communications gear for Atlantic Missile Range. Ships will analyze signatures of re-entering ballistic missiles, along with regular tracking duties. Bidding companies include Aerojet, General Dynamics, Alpha Corp., RCA, Sperry Gyroscope and Space Technology Laboratories.

▶ NASA Lewis Research Center's ion accelerator has been operated 10 hr. to date, using mercury vapor as the working gas. A laboratory model of a system that could be used as an electric space engine, the accelerator developes 0.01 lb. of thrust, or 2.3 hp., with an estimated efficiency of 87%.

▶ Orbiting solar observatory (OSO), scheduled to be launched by NASA next month with a Delta vehicle, will weigh 413 lb. The observatory's stabilizing inertia wheels will spin at 30 rpm., and its solar cells will generate 28 watts.

▶ Columbia University's Hudson Laboratory is contributing to development of new data processing techniques for Navy's Artemis active sonar anti-submarine warfare system.

To recall a bullet 12,000 miles away *requires Motorola systems reliability*

THE B-70 M&TC major system management contract places in the hands of a single contractor, Motorola, an unprecedented responsibility: positive recall of a Mach 3, nuclear deterrent force. At speeds over 2,000 mph – faster than a rifle bullet – crew and aircraft safety, as well as mission success, demand integration of myriad electronic functions with simplified controls and displays. ☆ The integrated M&TC system includes the functions of world-wide command communications (LRR) linked to the SAC Command Network; line-of-sight, short-range communications (SRR); improved tactical air navigational aids (TACAN); air-by-air IFF; air-by-ground IFF; aerospace ground support equipment (AGE); air-to-air rendezvous equipment; instrument landing system (ILS); and crew intercommunications. ☆ Motorola's role as a major electronic system contractor for the B-70 Valkyrie's Mission and Traffic Control typifies its systems management capabilities. Detailed information is available on request.

Military Electronics Division MOTOROLA

Qualified technical personnel
are invited to apply

CHICAGO 51, Illinois, 1450 North Cicero Avenue
SCOTTSDALE, Arizona, 8201 East McDowell Road
RIVERSIDE, California, 8330 Indiana Avenue

Washington Roundup

Progress Payments

Defense Department now will make full progress payments on cost-plus-fixed-fee contracts, eliminating the 80% ceiling imposed in 1957 by the Eisenhower Administration. The new rule will apply to all future contracts, and present contractors can start getting the 20% formerly withheld if they are willing to renegotiate their fees. Defense estimates that $175 million could be released if contractors take this step.

Pentagon apparently made the change last week to beat Congress. There was a strong chance the change would be written into law if Defense didn't move fast.

Cost reduction and procurement simplification were the official reasons given for the switch. The rule was a hangover from the 1957 economy drive in which then-Defense Secretary Charles Wilson imposed stringent limits on progress payments. These were eased somewhat when his successor, Neil McElroy, set the 80% ceiling. Now Defense says it wants to eliminate the extra cost of interest, incurred from industry borrowing to finance the 20% withheld, which is considered in setting a contract fee.

Progress payment ceiling was rescinded by Deputy Defense Secretary Roswell Gilpatric, another of the many signs of the influential role Defense Secretary Robert S. McNamara is permitting Gilpatric to establish for himself in the Pentagon.

This influential role is further emphasized in the McNamara memorandum giving the Air Force primary responsibility for military space programs. It says "the Deputy Secretary and I" decided to make the move, and it uses the term "we" in explaining the decision.

Gilpatric also issued the order to the services last week to increase defense contracting to small business. Goal is to increase Fiscal 1962 small business contracting 10% over the $3.4 billion in Fiscal 1960.

Space Probe Blunted

Scope of the House space committee investigation of the Defense order giving major space responsibility to USAF has been narrowed to the effect of the directive on National Aeronautics and Space Administration. The original aim was to explore the total effect of the directive.

A shortage of top Defense officials developed when the committee began to invite witnesses to testify. Deputy Defense Secretary Gilpatric agreed to appear and explain the move, but a rash of traveling kept other top officials from accepting, leaving the committee with a roster of second echelon defense witnesses.

Strong pressures apparently were brought to bear, both on the committee and on Pentagon officials, to avoid a controversial probe. Committee Chairman Overton Brooks considered issuing subpoenas to ensure a response from the top officials the group wanted to question.

White House is increasingly emphasizing international air transportation, and commercial aviation may become a prime foreign policy tool. The Administration feels that subsidy should be provided where necessary to support more extensive U. S. airline operations, particularly in remote areas where service is limited. Africa probably will be the first target in this effort.

Life Sciences Review

Top NASA officials conducted a review of the agency's controversial life sciences research plans late last week to prepare for some hard questioning on the subject when the House space committee resumes hearings Mar. 22. The review was made by NASA's Administrator James Webb, Deputy Administrator Dr. Hugh Dryden, Associate Administrator Robert Seamans and Life Sciences Director Clark Randt.

Space agency contends it won't duplicate other life sciences work and that the services will be satisfied with the pattern that eventually emerges. NASA says it plans to continue to call on military groups for assistance in its space medicine programs.

Major reoganization of the office of defense director of research and engineering is complete. Army Lt. Gen. William P. Ennis is the new assistant director for the Weapons Systems Evaluation Group. John B. Macauley is special assistant for foreign programs and Alvin G. Waggoner is special assistant for space.

Non-profit organizations connected with the Defense Department will explain their practices and policies to two House committees next month. House Armed Services Special Investigations Subcommittee, headed by Rep. F. Edward Hebert, will review nonprofit firms handling Defense research and development. House space committee will question all groups of this type doing business with the government.

President Kennedy said last week that he is looking into the disparity between salaries paid scientific personnel by non-profit organizations and those paid comparable civil service personnel. But he refused to take a stand on the issue.

—Washington Staff

Apollo, Large Booster Acceleration Due

Dryden outlines shifts in Fiscal 1962 programs; NASA assures Congress of no major budget change.

By Edward H. Kolcum

Washington—President Kennedy's space advisers will recommend substantial acceleration of manned space flight and large booster projects as the major changes in the Fiscal 1962 program submitted by the Eisenhower Administration.

Pattern of a shift in project emphasis became apparent last week as Dr. Hugh L. Dryden told the House Committee on Science and Astronautics that he does not agree with the "rate and scale" proposed by the Eisenhower budget for the man-in-space program. Dr. Dryden, deputy administrator of the National Aeronautics and Space Administration, said President Kennedy's views must be determined before NASA can present its revised program to Congress. But Dryden made it clear that his primary recommendations will be more funds for large booster development and for Project Apollo.

Both Dr. Dryden and NASA Administrator James E. Webb were careful, however, to tell the committee as it began NASA authorization hearings that their total Fiscal 1962 money requests will not vary a great deal from the $1.12 billion in the Eisenhower budget (AW Mar. 6, p. 28).

Webb opened the NASA authorization hearings by saying the Eisenhower budget requests will largely remain the same, and will be the foundation for the agency's program. "I believe we can find a way to present the results of our review . . . to fit in closely with the program for the previous budget," he said.

Dr. Dryden believes revisions "will consist mainly of changes of emphasis and levels of funding of projects."

Top NASA staff review began last Thursday on all major programs, and Webb said he plans to give the committee an indication of the direction of the review with "perhaps an official communication from the President" during the authorization hearings.

Booster development funds for advanced propulsion systems in the Eisenhower budget total $68.7 million for liquids, $24 million for nuclear, and $3.1 million for solid rockets. Maj. Gen. Don R. Ostrander, NASA launch vehicles chief, said he would like to have the solid and liquid funds each increased by $15 million (see p. 50).

Apollo funding level of $29.5 million reflects an extremely cautious attitude by the Eisenhower Administration on post-Mercury manned space flight plans. The total was a little more than half of the amount NASA feels it needs to get the Apollo program off to a fast start.

Within the framework of the Eisenhower budget, NASA can lower the priorities of some of its research programs in order to accelerate boosters and Apollo, or the agency can schedule its funding in anticipation of an immediate request for supplemental Fiscal 1962 funds.

Just as NASA has made its recommendation pattern clear, the House space committee has been clear in its hearings that it wants booster, communications, weather, basic sciences and planetary exploration programs advanced. This essentially leaves the agency without any low-priority projects.

The authorization hearings began last week, then were recessed until Mar. 22 because of other committee business, including a hearing on the Defense Department directive assigning the bulk of the military space mission to the Air Force (AW Mar. 6, p. 26).

NASA last week also cleared its Fiscal 1961 supplemental request in a brief appearance before the Senate Appropriations Committee. The original request of $49.6 million was cut to $49 million by the House Appropriations Committee, and this amount was approved by the House Mar. 7. NASA is authorized to use up to $500,000 of research funds for travel.

Projects covered by the supplemental include communications satellites, $24 million; Centaur vehicle, $16.2 million; Mariner long leadtime components, $5 million; nuclear engine technology, $2.6 million, and Scout vehicle, $1.8 million.

At the authorization hearings, Abe Silverstein, director of NASA space flight programs, discussed these agency projects:

- **Atlas Able failure** Sept. 25 was caused by a hydraulic failure in a servo unit. This prompted a question by the committee on the possibility of penalizing contractors when a failure is traced to negligence, carelessness or design failures. Cost of the Sept. 25 and Dec. 15 Atlas Able failures was set at $20 million.
- **Communications satellites:** The only common carriers which have expressed interest in a commercial system are American Telephone and Telegraph and International Telephone and Tele-

NASA, Defense to Confer on Space Projects

Washington—Defense Department and National Aeronautics and Space Administration have an agreement which prohibits either from starting development of a new space propulsion system without the written concurrence of the other.

The agreement, signed late last month by Deputy Defense Secretary Roswell Gilpatric and NASA Administrator James E. Webb, followed a highly critical report issued in January by the House space committee on the reputed booster controversy between NASA and the Air Force (AW Jan. 23, p. 33).

Preceding the agreement by a few days was development by the two agencies of a National Launch Vehicle Summary, a secret document containing characteristics of all existing and potential vehicles and concepts. Third document aimed at demonstrating cooperation to stem charges of controversy is now being prepared on rocket engines. The engine summary is expected to be similar in scope to the launch vehicle summary.

The Gilpatric-Webb agreement provides that when one agency plans a new vehicle development project, start of the project must await written acknowledgement by the other that the new development is consistent with the objectives of the national launch vehicle program.

Maj. Gen. Don R. Ostrander, NASA launch vehicle director, said the agreement does not give veto power to either NASA or the military on initiation of a launch vehicle program, but rather ensures that both are fully informed of programs under consideration. Whenever possible, he said, development will be planned to meet both civilian and military requirements.

The vehicle and engine summaries come from the launch vehicle panel of the Aeronautics and Astronautics Coordination Board, composed of both military and NASA members with Ostrander as chairman.

graph, although many companies other than common carriers have approached NASA on the project. Among them are General Electric, Westinghouse and Philco. Chairman Overton Brooks (D.-La.) said the House space committee will hold three days of hearings on the communications satellite program next month.

- **Centaur development vehicles** will carry multiple payloads in their test shots. Among them will be two packages similar to the S-3 energetic particles satellite, which will be carried by Centaur into a stationary orbit.
- **Ranger program,** to last 14 months and include five launches, will cost $100 million.
- **Value of the scientific** program is shown in Vanguard I, launched three years ago and still transmitting, which has "provided as much information as any satellite launched to date" on the shape of the earth and effect of the shape on orbits; Pioneer V, called the outstanding example of planetary exploration carried out by any nation, which successfully accomplished what the Soviets set out to do with their Venus probe, and Echo I, still able to reflect signals even though its surface area has decreased by 25%.

Silverstein pointed out that the Tiros III weather satellite will be launched during the hurricane season. This should help in determining the value of weather satellites in long-range forecasting and its effect on reducing storm damage.

Dr. Robert C. Seamans, associate NASA administrator, supported earlier testimony maintaining that NASA and the Air Force have a relationship "as close to 100% as possible." Responding to a question on whether the Air Force is withholding information from NASA on the USAF Discoverer program, Seamans said that because he is on the Air Force Scientific Advisory Board, NASA is fully acquainted with Discoverer.

In his testimony at the committee's propulsion hearings, Gen. Ostrander said NASA and Defense maintain the closest and best coordination and relations in propulsion and launch vehicles that he has ever observed in any program, "contrary to the many recent reports in the press and elsewhere."

At the same hearings, Dr. Wernher von Braun, director of NASA's Marshall Space Flight Center, said the agency wants to bring the cost of orbiting each pound of payload down to $25-$50 per lb., compared with the present cost of $10,000-$100,000 per lb. First generation costs ranged from $300,000-$1 million for each pound of orbital payload. Cost of a manned lunar mission could be cut from $30 million to $600,000 with recoverable boosters, he said.

Subpoenaed Lightplane Builders Surprised by Justice Dept. Action

Spokesmen for major U.S. business and utility aircraft manufacturers expressed "complete surprise" at subpoenas obtained by the Justice Department's Anti-Trust Division, directing them to appear before a federal grand jury of the U.S. District Court, Wichita, Kans., on Apr. 4th and make available records covering meetings and pricing schedules.

The subpoenas directed that the eight manufacturers served furnish the grand jury corporate records of all distribution and sales activities, records of all purchases from suppliers and copies of all corporate and financial records covering the period 1946 to the present. Named were Piper Aircraft Corp., Lock Haven, Pa.; Aero Commander, Inc., Oklahoma City, Okla.; Taylorcraft, Inc., Conway, Pa.; Mooney Aircraft, Inc., Kerrville, Tex.; Meyers Aircraft Co., Tecumseh, Mich.; Call Air, Inc., Afton, Wyo.; Cessna Aircraft Co., Wichita, Kans., and Beech Aircraft Corp., Wichita, Kans.

The Business Aircraft Manufacturer's Association, the Aerospace Industries Assn.'s utility plane council, indicated that it was in no way involved in the action. A spokesman for the council stated that, to his knowledge, U.S. light-aircraft manufacturers have never before been subpoenaed or indicted in anti-trust actions.

The grand jury also is interested in obtaining documentation from the subpoenaed parties regarding any communications passing between them and any competitors and relating to any meeting of two or more manufacturers or suppliers of light-aircraft. In addition, it wants copies of suggested list prices and schedules of discounts to distributors and dealers of their products.

Business aircraft industry spokesmen professed no knowledge of any complaints of alleged malpractices that might indicate the Justice Department's plans. They point out that they have not yet been cited for any alleged violations, if such exist, or any actions that might make them liable for prosecution. "We don't know what they are looking for," one executive told Aviation Week, and he suggested that perhaps this is merely part of a routine investigation that the Department of Justice is making of this segment of the aviation industry. He pointed out that no one should feel that the action reflects on the industry, since a government agency is exercising a right it has to conduct routine investigations.

Beech Aircraft Corp. Executive Vice President Frank E. Hedrick noted that the company is giving priority to the accumulation of requested informational materials and said that he believes that this extensive research of its operations will provide "proper and valid evidence of Beechcraft's successful endeavors in building a worldwide marketing organization whose sales increased 750% in the past decade."

"We believe also that our records will clearly indicate our own freely competitive position and policies as part of an industry that has grown approximately eight times larger in the past decade," he added.

Unmanned Redstone Test

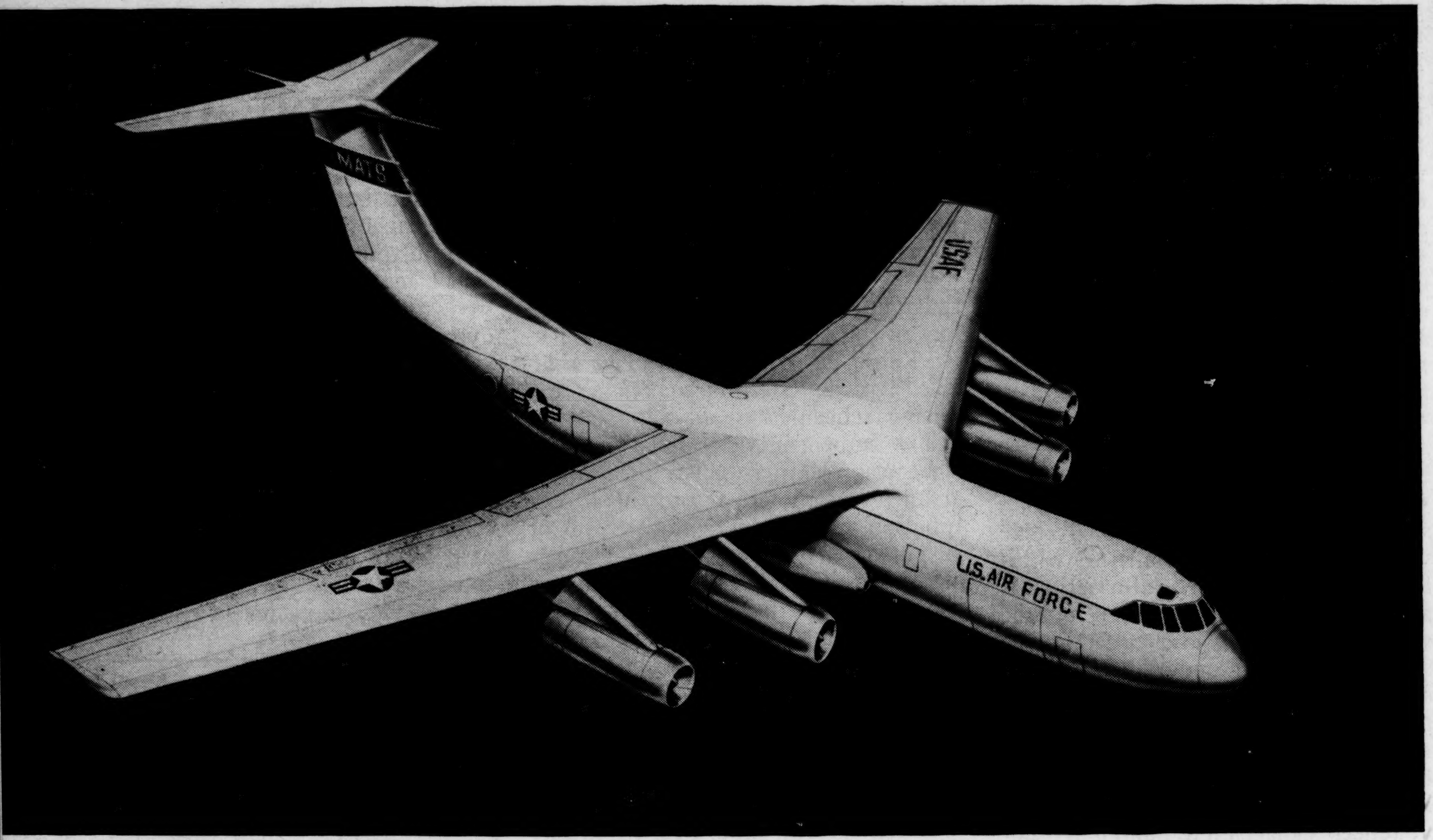
Washington—National Aeronautics and Space Administration has decided to fly another unmanned capsule on a Redstone to qualify the booster's liquid oxygen regulator control system before attempting a manned ballistic flight in the Mercury program.

Data from the MR-3 booster test, to be made within three weeks, and from a Little Joe high dynamic pressure abort will be assessed before a final decision is made on timing for the first manned Redstone launch.

Third Mercury-Redstone launch will be a test of modifications to the thrust regulator system which caused the booster in the second Redstone test to fly with a fully-open throttle, overshooting the planned impact point by 130 mi. (AW Feb. 6, p. 26).

Payload will be a full scale boilerplate model, built by Langley Research Center and flown previously in one of the early Little Joe tests. There will be no booster-capsule separation program, and no recovery attempt. The dummy capsule will contain a pilot escape tower so that the payload will duplicate the production capsule weight, center of gravity and flight dynamics characteristics.

NASA planned to fly McDonnell Aircraft Corp. production capsule No. 14 as payload of Little Joe VI to test operation of the pilot escape system under maximum dynamic loads. Similar abort tests of the escape system were made Nov. 4, 1959, and Jan. 21, 1960 using Little Joe and boilerplate capsule systems. Little Joe VI was designed to repeat the mission of Little Joe V (AW Nov. 14, p. 34), by subjecting a production capsule system to these loads, which could be encountered during an abort early in the boost phase.



LOCKHEED SS-476L TRANSPORT, which the company calls the Super Hercules, has a full-width fuselage loading ramp to expedite movement of bulky cargo and an aerial delivery system that permits dropping cargo in flight. It will be powered by turbofans.

Lockheed Wins Cargo Jet Competition

By David H. Hoffman

Washington – Lockheed Aircraft Corp. last week won the design competition to build a workhorse airfreighter that is intended ultimately to modernize the Military Air Transport Service fleet and cut the cost of carrying commercial cargo.

The new SS-476L transport, called the Super Hercules by Lockheed, is expected to blur the distinction between strategic and tactical airlift after it becomes operational in late 1964 or early 1965. This is because the high-wing, turbofan-powered freighter will combine the features of relatively short-range troop carrying transports, such as the Lockheed C-130-A, with the large load-carrying ability of aircraft in the Douglas C-124 category.

The White House took the unusual step of announcing the contract award itself, citing the "large number of press queries" as its reason. But the move also was an apparent attempt to demonstrate that the new Administration intends to move swiftly on technical decisions. The competition was completed so quickly that many significant details—such as the choice of engines—were still under discussion in the Pentagon after the announcement was made.

White House and Defense Department estimate that the SS-476L development program will cost approximately $1 billion. Current plans call for production of 132 aircraft, but the transport is to be compatible with airline requirements, and commercial orders also are expected.

Federal Aviation Agency and some of the airlines cooperated with the Air Force in preparing specifications for SS-476L, and FAA monitored the project through the selection of Lockheed as the contractor. The company will conform to both USAF and FAA standards to make sure the transport will be eligible for certification under Civil Air Regulations transport category.

The 476L transport, as designed by Lockheed in response to Air Force's Specific Operational Requirement (SOR) 182, will be able to:

- **Haul a 60,000-lb. payload** as far as 3,000 naut. mi. or a 20,000-lb. payload up to 5,500 naut. mi. while cruising at airspeeds between 440 and 500 mph. Thus, the aircraft is to be capable of nonstop flight across either the Atlantic or Pacific Oceans, depending on its takeoff payload.
- **Operate from 6,000-ft. runways** at maximum takeoff and landing weights. At its top weight of 155,000 lb., Lockheed's new C-130E Hercules will require a 5,860-ft. runway for a standard day takeoff. With 140 additional feet, the same runway could accommodate a Super Hercules weighing close to 315,000 lb.
- **Slow to an airspeed of 120 kt.** or less to discharge paratroops and heavy equipment. Air Force acquisition of 476L transports with air drop capability may fundamentally reshape the wartime missions assigned to MATS and to Tactical Air Command.

Low Bidder

The White House reported that Lockheed was "substantially the lowest bidder" in a competition with Douglas, Convair and Boeing. These four manufacturers concluded oral presentations before an Air Force source selection committee on Jan. 27.

In the current fiscal year, $30 million has been appropriated for SOR 182. The proposed Fiscal 1962 budget includes a request for an additional $98 million to be used to continue the project.

When Lockheed designed the aircraft to perform the SOR 182 mission, its engineers conservatively assumed that powerplants with a minimum thrust output of 18,000 lb. would be installed on the aircraft. This assumption apparently rules out all suppliers except General Electric and Pratt & Whitney in Air Force selection of an engine.

General Electric's lone entry in the engine selection contest was the MF-239C-3, an aft-fan powerplant that is based on the CJ-805-23 and which the company says was designed specifically for the SOR 182 requirement. With a thrust output estimated at 23,800 lb., the MF239C-3 could undergo flight test in less than two years and complete all requirements for Federal Aviation Agency certification in mid-1963, General Electric believes.

Instead of banking on a single engine, Pratt & Whitney submitted a series of proposals for advanced turbofan designs ranging from the 18,000-lb. thrust JT3D-3, which will be installed on some commercial Douglas DC-8s this summer, to a model reportedly developing 24,000 lb. thrust.

Development Schedules

Development timetable for the more powerful Pratt & Whitney engines probably parallels that of the MF239-C-3, but the JT3D-3 could be available long before the first Lockheed airfreighter is ready to accommodate it, avoiding any possible slowdown in SS-476L development and eliminating development costs of a new engine. These factors weigh in favor of the Pratt & Whitney powerplant.

But legislative pressure to spread the large 476L budget among a great many contractors and subcontractors was evident last week. Sen. Kenneth B. Keating (R.-N. Y.) last week urged Air Force "to keep a close watch" on subcontracts awarded by Lockheed under the SS-476L program and to define just how much control would be exercised over Lockheed's freedom of choice.

The original proposal drafted by Lockheed promised that about 61% of the total contract would be subcontracted. Department of Defense reported that "at least 50%" would be subcontracted. In comparison, Lockheed subcontracts about 30% of the work involved in producing C-130 series aircraft.

Also, President Kennedy said last week that the Defense Department has been ordered to increase contracting to small business, including research and development work.

Final Dimensions

Although the final dimensions and performance specifications of the Super Hercules may be modified by Air Force, the aircraft as designed by Lockheed has a 160-ft. wing span and a length of 150 ft. A 20% growth potential has been designed into its fuselage, and if this potential is exercised, a correspondingly increased payload probably could be carried.

Basic aerodynamic design and weight indicate that with powerplants in the 18,000-lb.-thrust category, the transport probably could maintain Mach 0.73 cruise at altitude. If thrust output per engine were boosted to 23-24,000 lb., the aircraft could cruise economically at between Mach 0.81 and 0.83, sharing this speed regime with current commercial transports.

The aircraft will be built at Lockheed's Georgia Division, where employment has fallen from a peak of 20,000 in 1957 to about 10,200 and was scheduled to drop to 9,000 by mid-1963. The SS-476L program will reverse this trend.

USAF Plans Additional Anti-ICBM Studies

Air Force is contemplating additional study contracts to back up three parallel study programs of satellite-borne anti-ballistic missile systems which are soon to be funded by Aerospace Corp. (AW Feb. 6, p. 34).

The satellite-borne anti-ICBM studies, several of which have been partially supported by the Advanced Research Projects Agency in the past two years, are generally known as Bambi (ballistic missile boost intercept). Additional studies will include:

- **Bambi control center—Air Force's Command and Control Development Division will ask for industry proposals on a study of control center requirements as soon as Aerospace Corp. selects what will likely be three winners of an industry competition for parallel Bambi system studies. Companies awarded Aerospace anti-ICBM contracts will not be permitted to bid on the Bambi control center because Air Force does not want the same organization handling both the control center and a system study. The reason is that a central contractor would have access to Bambi studies as they are in progress, creating the possibility that a Bambi systems contractor, were he also performing the center study, would be monitoring his competitor's activities.**
- **Countermeasures—Industry proposals for an Air Force contract to study countermeasures which may be needed to assist in destroying enemy ballistic missiles while they are still in their boost phases are due Mar. 29 at the Ballistic Missile Division. The winning bidder will be expected to analyze observable phenomena emitted by ballistic missiles during boost and then establish a systems concept for countermeasures using state-of-the-art techniques to counter the threat.**

Scout Will Launch Re-entry Experiment

Washington—Five-stage Scout launch vehicle will be flown to study re-entry phenomena at velocities up to 28,000 fps. in one of the next four vehicle development launches from Wallops Island, Va.

Payload will contain a 17-in. solid spherical motor which will be driven into the atmosphere at an altitude of 250,000 ft. to simulate the high re-entry velocity of a return from interplanetary flight. The spherical motor will be the combination fifth stage and payload.

In the elevator-type launch technique similar to the earlier Trailblazer firings, the first two stages will carry the payload to altitude, and the last three stages will be fired after the vehicle has nosed over.

Scout development program has been increased from six to eight flights, and National Aeronautics and Space Administration and the Navy last week signed a contract with Hercules-Allegany Ballistics Laboratory to improve the third and fourth stages of the standard vehicle propulsion system.

The $1.35-million contract calls for 40% more payload capability for the system by using advanced Polaris and Minuteman propellants in the upper stage engines. Advanced third stage ABL 254 engine will use the same case, and the fourth stage ABL 248 case will be lengthened to accommodate more propellant. Both stages will be heavier because of improved methods of propellant packing developed for the solid fuel weapon systems.

Existing Scout performance is a 150 lb. satellite in a 300-mi. orbit, or a 40 lb. probe to 8,000 mi. Advanced motors will raise the satellite capability to 200-250 lb., probe weight to 65-75 lb.

Advanced motor development will be funded jointly by NASA and the Navy. NASA's portion of the funds are in the Fiscal 1961 supplemental request.

NASA Awards Studies Of Large Boosters

Washington—Contracts to study the most promising approaches to economical large launch vehicles, with booster thrusts of 6-12 million lb., have been awarded to Lockheed Aircraft Corp., North American Aviation and General Dynamics' Convair Division.

The National Aeronautics and Space Administration studies will include consideration of solid, liquid, hybrid and nuclear rocket engines and of unconventional methods of construction (AW Dec. 12, p. 27). Other considerations are to include parallel and tandem staging; pump-fed and pressure-fed systems; large oxygen-hydrogen boosters and vehicle recovery.

Convair contract is for $130,000, Lockheed for $136,740 and North American for $160,000.

Price Group Will Fight to Save GE Direct-Cycle Nuclear Project

By Katherine Johnsen

Washington—Joint Congressional Atomic Energy Subcommittee last week promised what appeared to be a losing fight to keep alive General Electric's direct-cycle aircraft nuclear propulsion program.

After an executive session, Rep. Melvin Price (D.-Ill.), chairman of the subcommittee, stated that Department of Defense has flatly refused to support an increase in the Eisenhower Administration's aircraft nuclear propulsion (ANP) budget so that research and development could proceed on both the GE direct-cycle approach and the indirect-cycle approach of the Pratt & Whitney Division of United Aircraft Corp. This totaled $68 million—less than half the $150-million-a-year level at which the program has been sustained over the past several years. The Eisenhower budget also directed that a selection be made between the two approaches (AW Jan. 23, p. 28).

In addition, Price said that Defense Department furnished criteria that "leans" in favor of the Pratt & Whitney project in giving Atomic Energy Commission standards to weigh in evaluating nuclear engine development.

Price viewed Defense Department's position on the ANP budget and the engine criteria as "passing the buck" to AEC to make a selection in favor of the indirect-cycle project.

Subcommittee sources said that Dr. Herbert York, the outgoing director of defense research and engineering, is primarily responsible for Defense Department's position.

Air Force and Atomic Energy Commission have supported continuation of both the direct and indirect cycle approaches on the grounds that a proper technical selection between the two cannot be made until development has progressed further. This has also been the position of the Price subcommittee.

Dr. Glenn T. Seaborg, AEC's new chairman, reportedly leans toward Dr. York's position that continuation of only the indirect-cycle project is advisable.

If a selection must be made, Rep. Price said he would favor the direct-cycle project because it is further advanced and has promise of early flight.

General Electric has proposed to Air Force and AEC that its direct-cycle nuclear engine be placed in a modified B-52 to test it in flight by 1963.

With the indirect-cycle project, he commented, "there is a question whether we will ever have a nuclear-powered plane in the air." He said he considered it possible, but not likely, that under the present circumstances AEC would select the direct-cycle over the indirect-cycle project. In view of the subcommittee's position, Price anticipated that a final decision will be made by President Kennedy.

The key witnesses at last week's executive session were Roswell L. Gilpatric, deputy secretary of defense; Robert E. Wilson, AEC commissioner, and John H. Rubel, deputy director of defense research and engineering. Dr. York declined the subcommittee's request to testify, and Rubel was his substitute.

In his letter inviting Gilpatric to testify, Rep. Price observed:

The Atomic Energy Commission "did not participate in the development of the criteria [for the nuclear engine] nor were the criteria submitted to the Commission for approval or concurrence prior to issuance . . . neither the AEC nor the principal contractors engaged in the ANP program had made evaluations of the cycles presently under development relative to the criteria. . . ."

"Serious questions were raised" at previous closed-door subcommittee sessions, Price told Gilpatric, "as to the adequacy of certain of the criteria, particularly as to shielding and core life, and as to whether the effect of the criteria was to 'rig' the decision in favor of the cycle preferred by the DOD.

"As I have stated in my previous letters, I have been greatly disturbed with the poor management which has been provided for the ANP program."

The Price subcommittee's position is countered on the congressional front by strong opposition to the direct-cycle project in the House Appropriations Committee, which controls funds for the program.

New Production Post Created by Defense

Washington—James N. Davis, vice president of Bell Aerosystems Co., was appointed last week as deputy assistant secretary of defense for production and management.

The newly created post will concentrate on formulating decisions in regard to production lead time for weapon systems. Davis has held a variety of industry and government posts in management and research, including a term from 1951 to 1954 as special assistant for research and development to the undersecretary of the Army.

Meanwhile, appointments to two other defense posts were being delayed, apparently by political endorsement, security clearance and White House administrative programs.

Joseph S. Imirie, vice president of the Carborundum Co., who is slated to be assistant secretary of the Air Force for materiel is one (AW Mar. 13, p. 307). The other is Brockway McMillan, director of military research for Bell Telephone Laboratories, who has been picked to be assistant secretary of the Air Force for research and development.

John H. Dillon, a career Navy employe, was nominated last week to be assistant secretary of the Navy for financial management.

Anti-Satellite Potential Claimed for Nike Zeus

Washington—Nike Zeus anti-ICBM missile could with minor modification, become an anti-satellite weapon effective to 200 mi., and with major modifications could extend its effectiveness to 1,200 mi., according to Brig. Gen. David C. Lewis, Army director of special weapons development.

With "normal" development funding and emphasis, the 1,200-mi. capability could be achieved by 1967, Lewis said at a panel discussion on military applications in space at the annual meeting of the National Rocket Club.

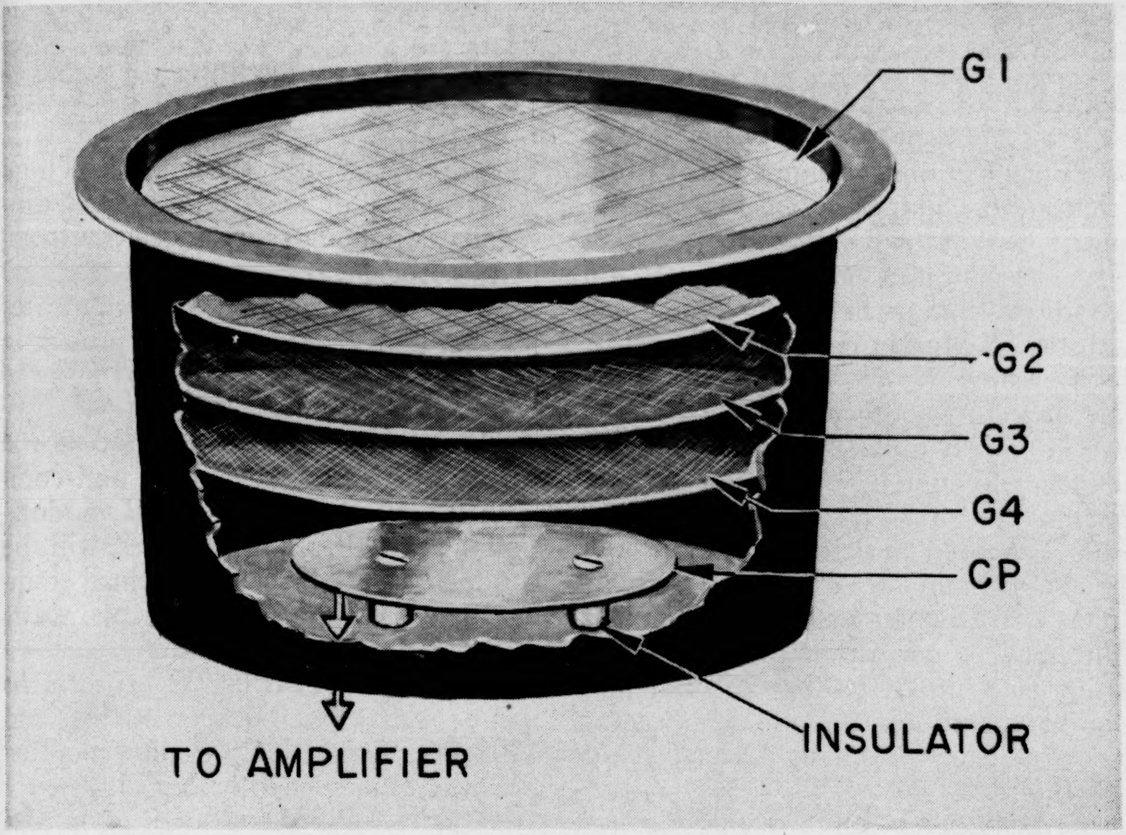
Navy's Transit navigation satellite will have an operational accuracy capability of 200-500 yd., Rear Adm. Thomas F. Connolly, assistant chief, Bureau of Naval Weapons for the Pacific Missile Range and Astronautics, said during the panel session.

Connolly said that, in quantity production, shipboard Transit receiving system could be installed in a tramp steamer for $10,000 or less and that he foresees the day when marine underwriters will require the unit as a prerequisite for insurance.

Asked whether the receiver could be made light enough for use in aircraft, he said that the Navy is principally interested in shipboard applications but that he sees no reason why the unit could not be developed for large aircraft.

Dr. Ivan A. Getting, Aerospace Corp. president, set the theme for the discussion when he said that there is a definite military role in space and that while the use of space for peaceful purposes must be considered an ideal aim, the U. S. must be continually aware that "terror weapons," such as bombs in orbit, are not only a possibility, but a probability. "We must face facts," he said.

"We cannot reserve the seas, land and air for war and space for peace."



PART OF NASA'S P-14 deep space probe payload, this instrument was built by MIT to measure the velocity, direction and density of solar winds. Effects of the winds, which are great streams of ionized gases, are well known: magnetic storms, aurora borealis and the recently-observed dumping, or emptying, of the Van Allen radiation belts for short periods of time, coincidental with solar eruptions.

Device on NASA's P-14 Satellite To Collect 'Solar Winds' Data

Boston—Long-standing scientific controversy on the direction, velocity and density of "solar winds"—great clouds of ionized gases which move through space—may be resolved by an experiment aboard the National Aeronautics and Space Administration's P-14 deep space probe, scheduled to be launched soon from Cape Canaveral. Some scientists claim that the winds roar through space like gales; others liken the gases to breezes.

The winds are to be measured by an instrument prepared for the NASA payload by the Laboratory for Nuclear Science of the Massachusetts Institute of Technology. Basically a Faraday cup (6-in. dia., 3.5-in. deep) fitted with a collector plate and four grids, the device will record protons only, for at apogee (120,000 naut. mi.) the only possible source of protons would be an ionized gas. Electrons, conversely, could be generated by other sources and thus give spurious readings.

Four grids serve to modulate incoming protons, repel electrons and suppress the photoelectric current stimulated by ultraviolet light on the plate, cup and grids. First grid is a ground. Second grid is periodically charged with positive square-wave voltages (0-5, 0-20, 0-80, 0-250, 0-1,000, 0-2,300 v.) at a constant frequency of 1,500 cps. These pulsating voltages not only modulate the protons with an a.c. signal by blocking all particles whose energy levels are lower than the charge on the grid, but also analyze their energy levels by comparing the number of protons striking the plate at 0 v. with those at 5, 20, 80, 250 v., etc. The third grid, a metallic cloth, is an electrostatic shield between the modulating grid and the collector plate. The fourth grid, negatively charged at 150 v., repels electrons and suppresses most of the photoelectric currents.

Protons are a.c.-modulated to distinguish the desired current on the 20-cm.^{2} collector plate from d.c. photoelectric currents generated by ultraviolet light. An extremely sensitive amplifier (for currents between 10^{-11} and 10^{-7} amps.) picks off only a.c. signals, demodulates them and passes them on to the payload's telemetry transmitter. Direct currents on the plate are grounded.

Velocity of the winds will be estimated by determining the energy levels of the protons as they pass the modulating grid, since proton speed and energy level are directly proportional. Density of the gases will be derived by dividing the number of proton strikes per square centimeter per second (or flux) by the velocity of the protons. Direction of the solar winds will be determined by variations in current readings, as the cup—which is flush-mounted in the side of the payload—rotates at 1.5 or 2 rps.

Kennedy Plan Asked On Conflict-of-Interest

Washington — President Kennedy was urged by a Senate group last week to propose a comprehensive legislative program quickly for modernizing the entire body of conflict-of-interest law.

The White House recommendations currently are expected by Mar. 30. The President's three-member task force studying ethics in government and conflict-of-interest is headed by Judge Calvert Magruder, an attorney and lecturer at Harvard University. It also includes Dean Jefferson Fordham of the University of Pennsylvania School of Law and Prof. Bayless Manning of Yale Law School.

Present laws—including seven statutes enacted over the past 100 years—"are disjointed, overlapping, ambiguous, and improperly focused," according to staff report of the Senate Subcommittee on National Policy Machinery, headed by Sen. Henry Jackson (D.-Wash). "They are anachronistic—addressed in many respects more to the problems of the 1860s than the 1960s." Jackson also heads a Senate Armed Services Subcommittee studying conflict-of-interest proposals relating specifically to Department of Defense, particularly requirements that officials divest themselves of stock holdings.

Primarily, the report highlighted the difficulties in assuring against the use of public office for private gain without maintaining unnecessary impediments to public service. Numerous congressional committees over the past several years have held long hearings on these problems—without attaining solutions.

After the report, endorsed by Sen. Jackson, was issued, Sen. Kenneth Keating (D.-N.Y.) called for application of the same conflict-of-interest laws to members of Congress that apply to members of the executive branch—a proposal which will probably further complicate the enactment of new legislation again this year.

Highlights of the subcommittee staff report were:

- **Present law fails** to recognize the special situation of the part-time consultant or the employe on a one-shot assignment whose services are vital in shaping foreign and defense policies.
- **Lawyers entering government** service are not only confronted with disruption of their practice, but face severe limitations on their practice for two years after their tour of duty.
- **Laws requiring retired** military personnel to forego retirement income while serving in a civilian government position, the report declared, are "serving today to hamper . . . recruiting top national security talent. . . ."

Carrier Communications Satellite Studied

Los Angeles—Joint commercial communications satellite business venture, involving the nation's common carriers and aimed at operating at $260-million stationary, 1,000-channel capacity earth satellite system after a four-year development period, is under preliminary study by General Telephone and Electronics, RCA Communications and Lockheed's Missiles and Space Division. Intended as a "carrier's carrier," the joint venture would lease channel capacity for transatlantic relay of telephone, telegraph and telex to international communications carriers.

Another major carrier, International Telephone and Telegraph Corp., is reported considering the joint-venture plan, proposed early this year by Lockheed, and may enter the preliminary study. The Lockheed proposal is an outgrowth of an exhaustive $½-million business planning study of a telecommunication satellite (Telesat) system conducted for the space-frame manufacturer by the management consulting firm of Booz, Allen & Hamilton. Additional political, legal and regulatory aspects of the Telesat program were explored in a supplemental study by the Washington legal firm of Pierson, Ball & Dowd.

Booz, Allen & Hamilton suggest financing for the enterprise primarily from U. S. telecommunications carriers, partly from foreign carriers (whose participation would be limited by law to 20% equity ownership), and from space technology companies which might provide technical support and actual hardware. Public stock sales and debt issues are an additional anticipated financing possibility. Boosters, launch vehicles and other hardware probably would be obtained through open competition among space technology firms, whether they be participants in the joint venture or not.

Lockheed is anxious to get the operation under way but is believed to prefer to hold only as sufficiently large an interest in the joint-venture enterprise as necessary to show its good faith, since it is not a carrier itself. Industry sources say the company is seeking participation by at least one additional space technology firm.

Whether the venture is actually begun, let alone successful, may hinge on the attitude toward it of American Telephone and Telegraph Corp., the sole U. S. carrier of intercontinental telephone traffic. AT&T has been apprised of the Lockheed plan. It is pushing its own plans for a low-orbiting commercial communications satellite project for which it had Federal Communications Commission authorization to conduct a one year experiment (AW Jan. 23, p. 39).

A delegation of AT&T scientists and engineers from its Bell Telephone Laboratories in Murray Hill and Whippany, N. J., visited Aerojet, Convair and Douglas here in Southern California two weeks ago to inquire about availability of suitable launch vehicles for its program. Industry sources, sympathetic to the Lockheed Telesat plan, say the project cannot be a success without AT&T participation, but predict that this may be forthcoming if the Lockheed plan progresses beyond the preliminary study phase and if it gains necessary support among telegraph and telex carriers.

Participation of the major carriers would be almost essential, the Booz, Allen planning study concedes, to ensure commitments for channel leases, to assist in obtaining agreements with foreign carriers and to provide needed communications experience.

Function of the Telesat system would be to serve as an overseas link, relaying telecommunications initially from the North American to the European continents and vice versa. It would not provide long-distance land communications. Its role would be that of a connecting carrier or a "common carrier's carrier," offering leased circuits to all voice and record (telegraph and telex carriers) for overseas message transmission via satellites. The satellite communications would be distributed through existing ground networks now operated by existing carriers. This role would require a carrier status and would be subject to FCC regulation.

Participation in the preliminary study which is attempting to determine the feasibility of the plan does not bind any of the participating companies to actual implementation of the study.

The proposed Telesat system initially envisons use of one stationary satellite (satellite in an equatorial orbit at roughly 22,300 mi. altitude, giving it a rotational period equal to that of the earth) over the Atlantic, and another sometime later over the Pacific. There will be three or four test launches during development. The payload was specified by Lockheed to be limited to 1,000 lb., but the Booz, Allen report indicates this should be capable of providing 1,000 two-way voice channels or more by 1967.

During the R&D period, space-borne equipment will be developed, and communications link analyses and modulation and multiplexing studies will be conducted. Anticipated payload radiated powers will be less than two watts at frequencies between 1,000 and 10,000 mc. Communication bandwidths will be somewhere between 50 mc. and 500 mc., depending on the modulation techniques finally selected.

Vehicles suitable for putting the payload into the 22,300-mi. orbit would include a modified Lockheed Agena C, the basic version of which is in the design stages, and the Convair Centaur, according to Booz, Allen.

Cost of the initial program, the management consultants say, would include $54.5 million for R&D, $82.5 million for experimentation and test, $44 million for boosters, vehicles and payloads, $78.4 million for modifications to base and launch equipment, conversion and construction of 20 transmitting and receiving stations near major communication centers of the world, four of them at the gateway cities of the U. S. Another $176 million, these estimates continue, would be needed for satellite replacement through 1980. The Booz, Allen study indicates that the system should be profitable by the early 1970's.

While the Booz, Allen study says the low-altitude satellite system may be currently more practical, the stationary system—which was favored in space communications' briefs filed with the FCC by Radio Corp. of America, Hughes Aircraft, General Telephone and Electronics as well as Lockheed—would have these advantages:

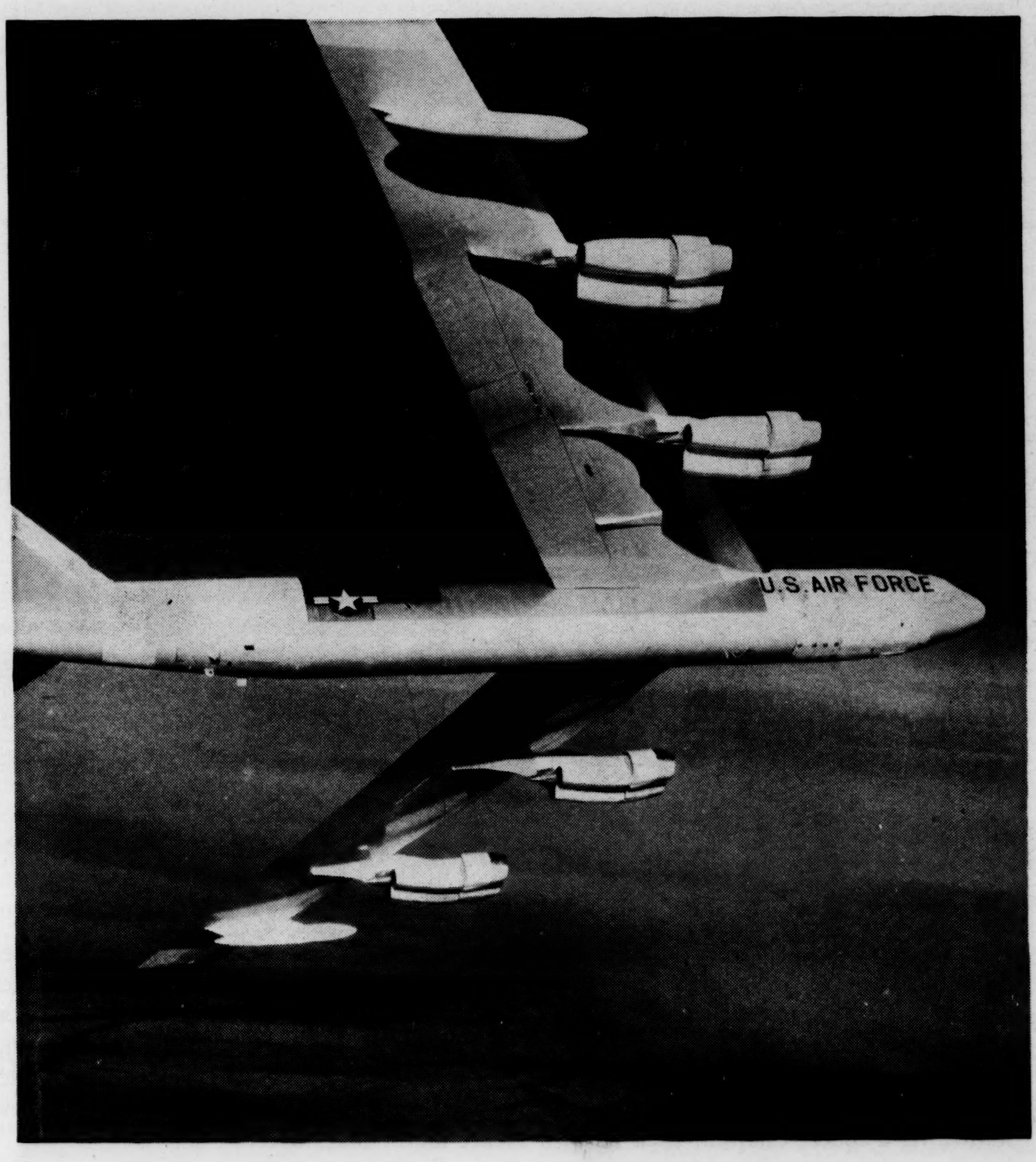
- **Flexibility**—Three satellites could provide continuous repeater telecommunications for 98% of the earth's surface without delays or interruptions because of the unavailability of the satellite or of switching from satellite to satellite.
- **Less interference**—Synchronous system would be a source of less interference with surface microwave and airborne systems in controversial frequencies (AW Feb. 6, p. 79).
- **Cost**—In the long-run, the stationary system will be less expensive, although the low-orbiting satellites are cheaper on a satellite-for-satellite basis. The stationary system would require fewer satellites, less complex and fewer ground stations.

Centaur Mating

Cape Canaveral—Centaur stage was mated vertically last week for the first time with its modified Atlas booster. It was used in the first systems checkout of the new Complex 36 here with the complete Atlas Centaur vehicle. The Convair Centaur stage was complete with two Pratt & Whitney LR115 engines, but it is not the stage designated to make the first Centaur flight.

Turbofan-Powered B-52H Makes First Flight

First production Boeing B-52H is undergoing initial flight trials at Boeing Airplane Co.'s Wichita, Kan., Division prior to delivery to Strategic Air Command's 379th Strategic Wing, Wurtsmith AFB, Mich., in May. Structural changes, reducing weight and permitting increased fuel stowage, in addition to use of new Pratt & Whitney TF-33 turbofan engines, provide important gains in unrefueled range over the earlier B-52G models. Although range figures are still secret, the B-52H's TF-33 fan engines provide a fuel consumption at least 15% lower than the conventional P&W J57 turbojets fitted to earlier models at cruise levels, in addition to giving a takeoff thrust some 30% higher, eliminating the need for water injection on takeoffs. Takeoff thrust rating of the TF-33 is 17,000 lb. at sea level under static conditions. The B-52H wing structure represents a major revision in structural layout, although dimensions are the same. The fire control system is an Emerson Electric AN/ASG-21. Pilot-copilot instrument presentation is revised for greater efficiency —new attitude and position presentation, for example, is integrated, providing two instrument faces in place of the former six. Gross weight of the B-52H is increased over the B-52G's 488,000 lb., although the figure is still secret. An important addition to the B-52H weaponry is the new solid-propellant-powered Douglas GAM-87A Skybolt missile (AW Jan. 30, p. 15), at least four of which can be carried externally on pylon launchers under Superfortress wings.



Soviets Predict First Manned Flight On Basis of Sputnik IX Recovery

Moscow—Soviet scientists, commenting on their successful fourth biological satellite experiment, are confidently predicting that a Russian cosmonaut will make the first manned space flight.

Sputnik IX was launched and recovered Mar. 9 (AW Mar. 13, p. 305) with its payload of a four-year-old dog, guinea pigs, black mice, insects and plant seeds.

Soviet Premier Nikita Khrushchev told an agricultural conference in Siberia last week that Russia is "confident that the time is not too far off when the first spaceship with a man aboard will dash into outer space."

Scientific comment carries a similar belief, although predictions include the usual reservation that a Soviet man will not be launched until it is safe. But with the U.S. planning to launch a Mercury pilot on a ballistic flight next month and to fly a manned orbital mission before the end of the year, Soviet scientists are now putting emphasis on the imminence of Russian manned flight rather than on problems which must be solved.

Kh. Koshtoyants of the Armenian Academy of Sciences said Soviet scientists "are fully aware of their great responsibility on the eve of manned space flight and are deeply convinced that first space travel will be made by Soviet airmen."

Soviet press reports said that the main purpose of Sputnik IX was proving out "complex facilities called upon to secure in airtight cabin conditions necessary for normal activity of organisms in manned space flight." The recovered cabin carried a female dog, called Chernushka, who survived the flight with "no abnormal deviations."

Flight was made during a period of "increased meteorite activity," according to Vsevolod Fedynsky, a doctor of sciences. He said the "huge flying weight of the Soviet vehicle (10,340 lb.) enables the outer casing to be heavy and strong enough to afford protection against meteorite impact."

Fedynsky indicated the outer structure of the orbital vehicle was dented by micrometeorite impacts.

The payload orbited an unspecified number of times between the altitudes of 154.6 and 114 mi., and the Russians say it was exposed to "intense ionization" of solar and cosmic radiation. This statement would be disputed by U.S. scientists, who maintain that radiation is not hazardous at these low altitudes.

Soviet Academy of Sciences said the flight and payload environmental conditions were normal. The dog's behavior was monitored by television. Cabin temperature varied between 61F and 68F, and humidity ranged from 37 to 40%.

Data from Chernushka and survivors of two previous flights—Byelka and Strelka—will be used to determine the effects of acceleration, deceleration and weightlessness on vision and cortex processes of man, according to P. Varin, member of the Academy of Medical Sciences. He said scientists have obtained "revealing information about the effects of unusual stimuli on living organisms—rasping noise of rocket engines, hull vibration" and loads.

Dogs Preferred to Apes

Varin said Russia prefers using dogs to apes in experiments because dogs remain calm while apes are nervous and more excitable. The U.S. uses monkeys and chimpanzees as space experimental animals because they have the same organ suspension and placement as man.

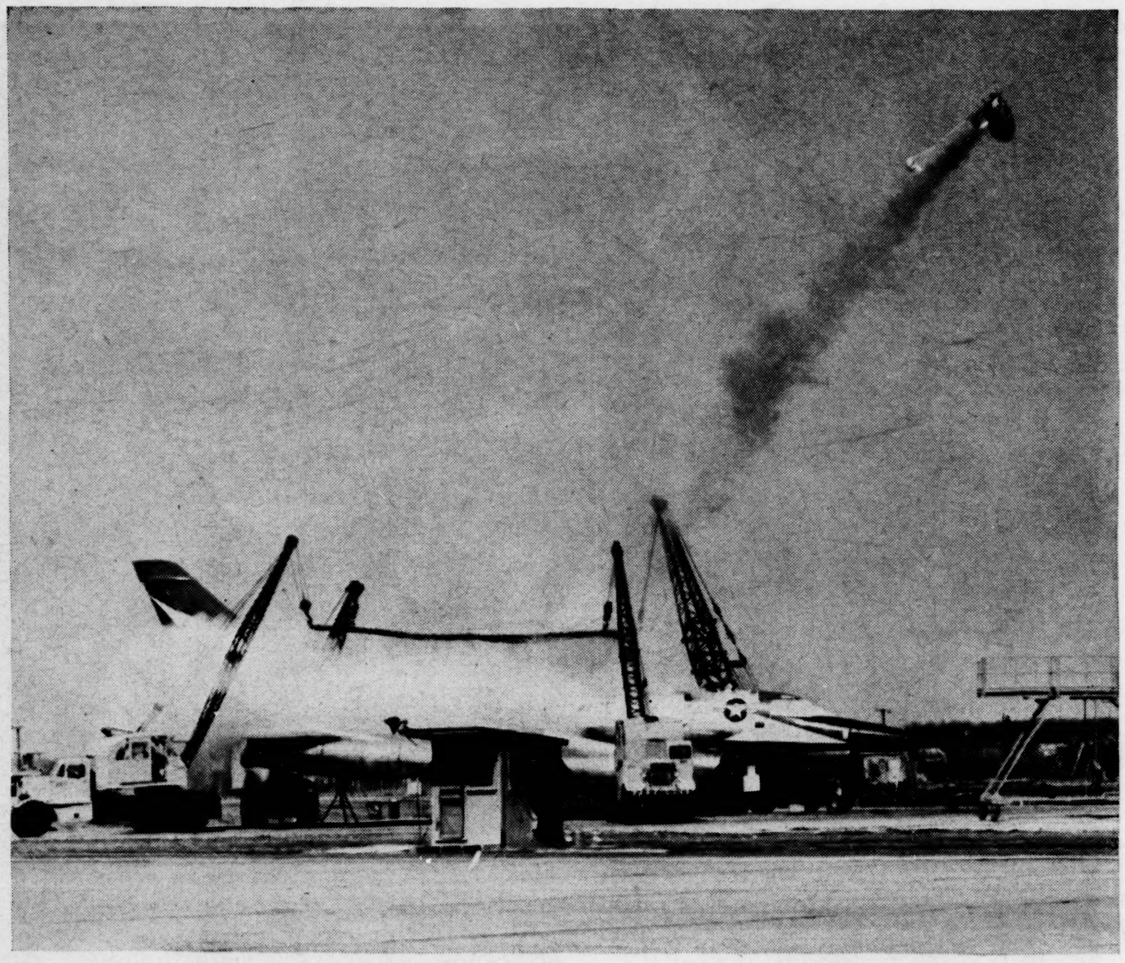
Demonstrating a rare lack of public unanimity among Soviet scientists, Pravda published several stories aimed at dampening earlier enthusiasm on the imminence of manned flight.

Ival Maisky, director of the Soviet Experimental Biology Institute, said it is not clear "what overloads" man can safely take during launch, re-entry and landing, nor is it conclusive that weightlessness is not dangerous.

Koshtoyants said further improvements in radio, telemetry and television are important for success in biomedical research. Ukranian Academician Nikolai Barabashov said that a series of animal experiments in short and extended orbital flights is under way to clear "numerous questions that have to be disposed of before man goes into space himself."

Dr. Sandoe Lukacs of Hungary, medical adviser of the Union of Technical and Scientific Associations, said the U.S. is lagging "very much behind the Soviet successes. Up to now," he said, "the Americans have succeeded only in bringing back monkeys after a few minutes' flight on a ballistic trajectory, but Soviet research scientists have succeeded for the second time in landing living creatures in a predetermined area from a Sputnik circling our globe."

Lukacs concluded that Russian experiments have demonstrated the fundamental proof of design and capability for manned space flight.



Supersonic Ejection Capsule Tested

Ejection of a manned crew escape capsule from a Convair-Ft. Worth B-58A Hustler supersonic bomber traveling at speeds of more than 850 mph. will be carried out over Edwards AFB, Calif., this summer. Tests series will comprise the fastest controlled ejection of man ever made from an airplane. Initial ground testing has been carried out, including ejection of a capsule from a stationary B-58A at Convair-Ft. Worth (above). Capsule, developed and built by Stanley Aviation Corp., Denver, for Convair, is fired from the crew station via a rocket catapult, then its own rocket motor takes over.

Venus Probe Carries Long-Range Antenna

Soviet Venus probe, which has not transmitted signals since Feb. 27, may resume broadcasting in mid-May when a large paraboloid antenna is scheduled to unfold from the payload structure for interplanetary range communications.

Possibility that the probe became silent by plan rather than through a malfunction was indicated in a relatively detailed Moscow News account of the probe and its instrumentation. This report says the probe contains aerials used for orbit and earth phase communications, and a rod antenna for medium-range transmissions. The long-range antenna is a 6.6-ft.-dia. paraboloid with a pencil beam, which is to unfold as the probe approaches Venus. Closest approach to the planet will come May 19-20.

Communications with the probe ceased at a range of 4 million mi. and none of the public Soviet scientific reports have hinted that this was planned. Speculation in the U. S. was that the solar conversion system went out, or that the orientation system failed and the probe was tumbling.

It is possible that Russia is waiting to determine whether the interplanetary communications system will function before making any announcement. It could produce a propaganda coup, since it would eclipse the U. S. communications ranges record of 22.5 million mi. established by Pioneer V. Soviet probe will be 43.5 million mi. from the earth at its closest approach to Venus.

The 1,418-lb. probe, called an automatic interplanetary station, consists of a pressure vessel 6.52 ft. long and 3.44 ft. in diameter. Solar paddles contain cells with different coatings to measure their efficiencies, and an earth-seeking sensor is attached to the outboard corner of one of the paddles. A sun-star seeking sensor is attached to the pressure vessel.

Major subsystems of the probe are:

- **Orientation,** in which the sun seeker locks on the sun for stabilization, to "insure in the neighborhood of Venus that the paraboloid aerial always points toward the earth." System also eliminated tumbling and free rotation when the probe was launched from orbit.
- **Instrumentation,** for measuring cosmic rays, magnetic field intensities, charged particles and solar corpuscular radiation, and micrometeorite impact.
- **Radio,** powered by chemical batteries continuously charged by solar cells to measure probe movement in relation to the earth; to transmit scientific measurements and internal environment, and to receive commands. The Soviet probe has both command capabilities and self-contained program capabilities.

Soviets continue to maintain an official secrecy about its launch vehicles and ground complex. The Moscow News, however, identified as a control point the Center for Long Distance Cosmic Radio Communications, which is the filter center for tracking site reports. Tracking stations have been equipped with narrow-band, low-noise receivers and with large antennas for the Venus project.

The Cosmic Radio Communications Center computes the projected trajectory and programs pointing directions for remote stations. Antennas can be "trained to any point of the celestial sphere with an accuracy of several minutes of arc," according to Moscow News. Solar orbital elements are now 92.8-million-mi. aphelion and 65.9-million-mi. perihelion. Late in February, Tass gave these figures as 94.7 and 66.7 million mi.

AAS Rejects Merger With Rocket Society

Washington—American Astronautical Society has again rejected an American Rocket Society proposal that the two organizations merge, and the AAS Board has decided to halt further efforts toward a merger.

ARS proposal, second since 1959, was made to reduce what it considers the number of organizations with overlapping interests, which would reduce the growing number of technical meetings—a sore point in government and industry because of the time and expense they demand.

AAS feels that although each technical society has its strong areas of special interest, there is a vacuum in the integration of the multitude of technical and scientific disciplines, and the Astronautical Society is moving toward an interdisciplinary membership.

AAS wants to keep its membership small but representative of the growing number of specialties in physical and life sciences, President Alfred M. Mayo told Aviation Week.

The issue of the growing number of technical meetings may come to a head as a result of two independent discussions, one held last week and another scheduled next month. American Society of Mechanical Engineers, Institute of the Aerospace Sciences, ARS and Society of Automotive Engineers met last week at the request of Harry Guggenheim of the Guggenheim Foundation, to explore ways of reducing the number of technical meetings.

Aerospace Industries Assn. guided missiles council has asked AAS, ARS, IAS and ASME to meet Apr. 20-21 at Hanscom Field, Mass., to discuss the same subject.

News Digest

Thomas D'Alesandro, Jr., former mayor of Baltimore and Democratic Congresseman from Maryland, was nominated last week to be a member of the Renegotiation Board.

Study contracts to establish design requirements for 2-3-million lb. thrust launch vehicles based on F-1 and J-2 booster engines were awarded last week to Convair, North American Aviation and Martin by National Aeronautics and Space Administration.

Northwest Airlines has filed a $2.5-million suit against Lockheed Aircraft Corp. and General Motors Corp. for the loss of an Electra turboprop transport near Tell City, Ind. last year.

General Electric Ordnance Department has a $20-million Navy contract to continue work on the advanced Mk 84 Polaris submarine fire control system.

Two new suits have been filed against Chance Vought Corp., by Ling-Temco Electronics, Inc., both of Dallas, Tex. One seeks acquisition of Vought's stockholder list in preparation for Ling-Temco's waging a stockholder proxy fight, which it said it plans to conduct at Vought's May 25, stockholder meeting, the other suit challenges Vought's right to issue stock, allegedly in violation of stockholder pre-emptive rights.

USAF-Convair Atlas E landed about 2,000 mi. short of its planned 9,000-mi. range when the sustainer engine shut down prematurely in a test last week at the Atlantic Missile Range.

Harold B. Finger has been appointed assistant director for nuclear applications in the National Aeronautics and Space Administration launch vehicle programs office. Previously nuclear programs chief under the propulsion assistant director, Finger remains manager of the joint NASA-AEC Space Nuclear Propulsion Office.

California Eastern Aviation plans to change its corporate name to the Dynatronics Corp. to reflect its diversification in products and services. The change must be approved at the company's annual stockholders' meeting, scheduled June 14.

Thiokol Chemical Corp., reported to be discussing merger possibilities with Baltimore Paint & Chemical Corp., said that Baltimore Paint & Chemical was one of a number of companies it has considered for acquisition but that Thiokol has made no proposal to BP&C.

SAS Seeks to Double Its Working Capital

Airline is asking three Scandinavian governments for funds to overcome financial hazards it faces.

By Cecil Brownlow

Stockholm—Scandinavian Airlines System, which has expanded four-fold over the past 10 years without once increasing its basic capitalization, is striving to overcome a series of crimping financial hazards—some of them transient, others more chronic.

Buffeted by the loss of approximately $16.8 million during its last fiscal year (AW Feb. 13, p. 47) and facing prospects that are almost as bleak for the current 12-month period, SAS, as an immediate step, is asking the governments of the three Scandinavian countries directly concerned to provide funds that would approximately double the carrier's present working capital of $31 million to about $60 million.

The three governments—Denmark, Norway and Sweden—own 50% of the airline's stock. The remainder is divided among private capital, and SAS officials are proud of the fact that the carrier has not received a subsidy payment since the time of its post World War II inception.

However, such forces as route expansions, the expenditures necessary to become a member of the jet age, declining market value of piston-engine equipment still on hand, the necessary awkwardness of the organization itself —i.e., the need of maintaining a headquarters in the capital of each of the three nations, of splitting maintenance work and schedules in an effort to satisfy all three—make additional capital mandatory.

"And," as one official explains, "we would be hard put to find sufficient money from private sources. So, we have to turn to the governments."

The respective ministries of the three nations are presently studying means of meeting the request, and there is little doubt that aid will be forthcoming in one form or another, with the load split roughly along the lines of government investment in the corporation. Sweden holds three-sevenths of the government-owned stock, Denmark and Norway two-sevenths each.

Some of the airline's financial difficulties are new—a direct result of modernization and expansion — others have gripped the carrier almost from its inception.

They include:

- **Expenditures of an estimated** $147 million for the jet equipment needed for the carrier's various route structures and the facilities to handle them plus late delivery dates.

In 1960, SAS had hoped to have the first of its seven Douglas DC-8s in service at the beginning of the transatlantic summer tourist season which opens Apr. 1.

Because of delivery slippages, the airline missed its target by almost two months and, forced to face jet competition with piston equipment during this period, lost out on considerable potential revenues.

Slippage in delivery dates of the Convair 990 medium-range transport from an original March, 1961, to the present October schedule (see box) is even more severe and means that SAS may miss out entirely on the summer jet season on some of its Far Eastern, South American and African routes.

"I don't know what we can do about it," one official complains, "and when the bill comes around, we will still have to pay it."

- **Cost of modifying** the leading-edge wing section of its DC-8 fleet to reduce drag, increase range and cut fuel requirements (AW Nov. 7, p. 39) and converting their engines—the 17,000-lb.-thrust Pratt & Whitney JT4A—from the -9 to the more powerful -11 versions in order to increase available takeoff thrust.

SAS engineering officials estimate that the wing modification for each aircraft will cost approximately $300,000—$200,000 to Douglas Aircraft Co. for the kit plus another $100,000 for the necessary tooling, labor, etc.—to do the work at Copenhagen's Kastrup Airport. JT4 conversion cost is estimated at $100,000 per engine, or about $400,000 an aircraft. Over-all cost of the DC-8 modification program to SAS is about $4.9 million if present figures remain firm.

The airline has pressed Douglas to share the modification costs since it says the aircraft failed to meet the specific fuel consumption figures quoted by the company but adds that, thus far, the U. S. firm has declined to do so.

- **Investment in two foreign carriers**—Guest Aerovias de Mexico, S. A., and Thai Airways International—as a means

Convair 990 European Deliveries Delayed

Copenhagen—Initial delivery date of the Convair 990 medium-range jet transport to its two European customers—Scandinavian Airlines System and Swissair—are being delayed by at least another five months.

Present target date of October for first deliveries means that both carriers will miss out on the profitable summer season and lose potential revenues estimated by some to be well above a million dollars.

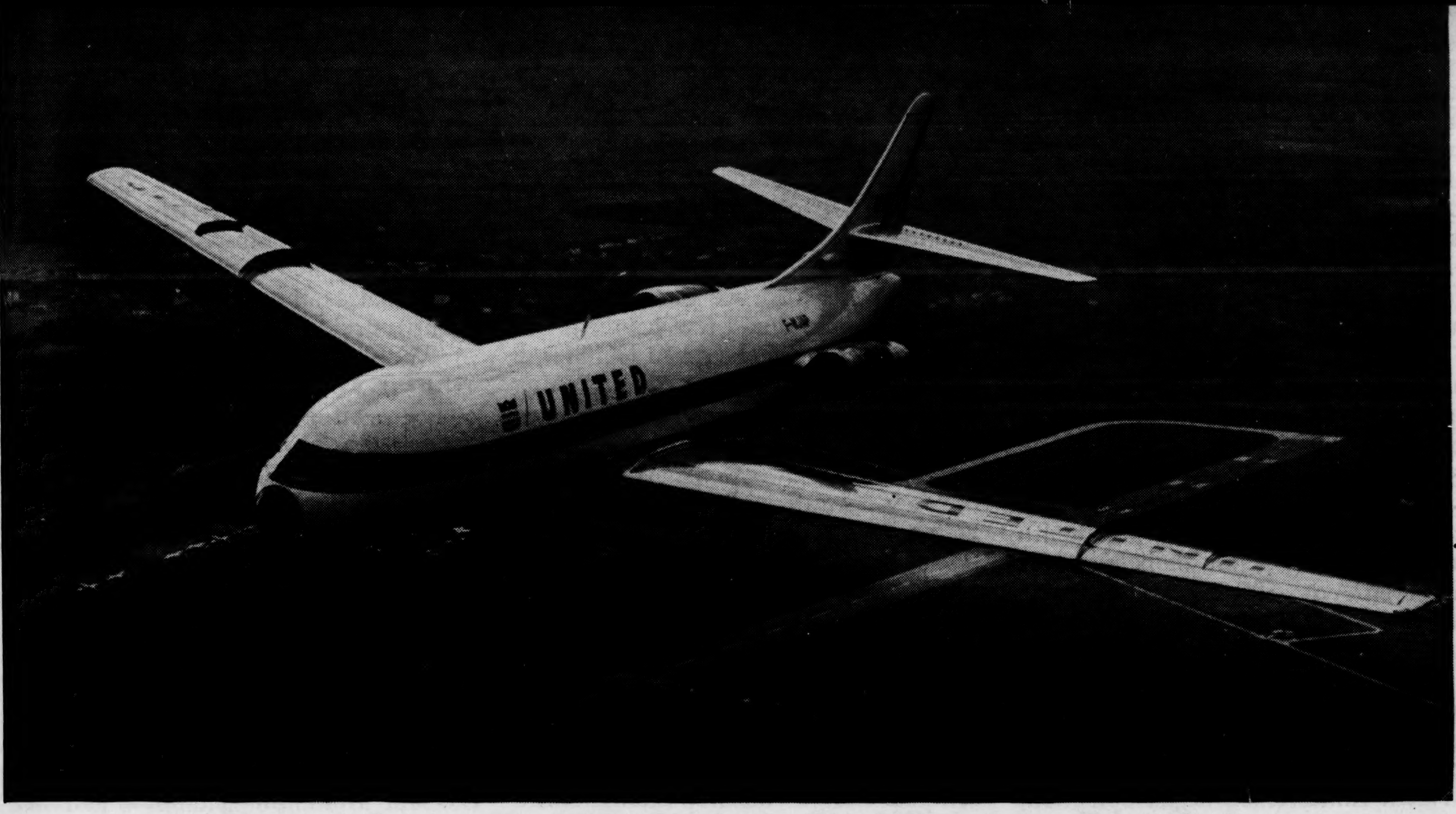
Swissair had counted heavily upon receiving the aircraft in time to begin a summer jet schedule to the Far East. It has been facing jet competition in this market for the past year while relying upon Douglas DC-6B piston engine aircraft to serve its own routes and has been anxious to make the switch at the earliest possible date.

SAS also urgently needs the aircraft to compete effectively on a number of its Far Eastern, South American and African routes.

Swissair and SAS officials have been conferring with Convair in San Diego over the reasons for the delays and over the possibility of leasing shorter-range Convair 880s to help carry them through the summer period. Some officials of both carriers have advocated a flat cancellation of the orders.

One apparent reason for the new delay is discovery of serious vibration in the engine nacelles. Engine mounts reportedly will be shortened by 28 in. each in an effort to correct the problem.

Original delivery date quoted to Swissair for the first of seven 990s on order was March, 1961. This was postponed to May several months ago following delays in the first flight of the prototype. Word on the newest delay was received earlier this month. Two of Swissair's 990s are to be leased to SAS which has ordered another two directly from Convair.



United Caravelle VIR Cockpit Modifications Detailed

United Air Lines Caravelle VIR, currently undergoing flight trials in preparation for initial delivery in April or May (AW Feb. 20, p. 37), displays 'bubbled' contour modification to upper portion of cockpit to permit more room in the flight deck. Rectangular-shaped cockpit window and the deletion of an antenna spine from the fuselage are other alterations to the original design configuration.

of expanding the airline's over-all route structure and of boosting its international scope. Neither carrier paid a return on investment last year, but SAS officials say Thai Airways is fast establishing itself as a strong regional carrier in the Far East and feel that it may begin to yield a return within the next few years.

Their outlook for Guest Aerovias is not so optimistic although they see a possible potential for the carrier if it can find the funds to finance a DC-8 purchase and compete on an equal footing with its competitors over its major international route—across the mid-Atlantic between Mexico City, Miami and Madrid. Current piston equipment used on the run is losing money steadily.

- **Annual sharp decline** in winter load factors well below industry averages. For the last quarter of 1960, as an example, SAS passenger load factors for the North Atlantic were 47½% as compared with 55½% for the industry as a whole. Summer North Atlantic load factors, on the other hand, are comparable with the over-all figures for the industry—66½% for SAS, 69½% for the industry in 1960. Effort to close this gap, which threatens to grow larger as the capacity of the transatlantic carriers increases, is a major factor behind several of SAS's current sales campaigns.
- **Upkeep of headquarters** and maintenance facilities in Copenhagen, Oslo and Stockholm to fit the tri-nation structure of the airline and the resultant high costs. DC-8 airframes, for instance, are maintained in Copenhagen, while their engines are overhauled in Stockholm.

So far as the latter problem is concerned, there is no apparent panacea. Each of the three nations quite naturally wants its share of the work-load and the prestige accruing from the sponsorship of, and participation in, a modern international airline.

SAS has been using Copenhagen's new airport as the DC-8 terminal for all flights and had hoped to continue to do so for at least another year. As one official explains:

"When we put the DC-8s into service, we found that the best way to utilize them would be to have all flights originate in Copenhagen, feeding down the Stockholm and Oslo traffic by Caravelle."

Sweden, however, is constructing a modern $30-million airport at Arlanda in the midst of a forest of tall pines approximately 26 mi. from Stockholm. Although construction is still under way, and will be for the next several years, the 11,000-ft. runway is complete and there are facilities enough to handle the passengers—the present reception building will revert to its intended role as a garage once all the airport buildings are completed. And Sweden is anxious to become an international, transatlantic DC-8 terminal point at the earliest possible date.

So, when the summer schedules go into effect on Apr. 1, two of the planned 22 weekly DC-8 flights from Scandinavia to New York will originate in Stockholm.

Arlanda also is scheduled to take over all international traffic originating or terminating in Stockholm by Apr. 1, 1962, leaving the smaller, more congested Bromma Airport nearer the city as the center for domestic traffic.

Move to Arlanda, necessary to find the land for the longer runways needed today and to avoid jet-noise complaints from the homes and industries surrounding Bromma, is another example of the jet age cost to SAS.

Although the Swedish government is financing the construction of the airport itself, SAS is investing approximately $7 million there on a line maintenance hangar that, when completed, will be capable of handling eight DC-8s simultaneously.

It also means that the airline will be forced to build a new Stockholm terminal building in the suburbs to replace the present site in the center of the city in order to handle the passenger flow with a minimum of difficulty. Under present planning, outgoing passengers will report to the terminal, which will be a 5-to-10 min. taxi ride from the heart of the city, and then be transported to Arlanda by express bus.

A four-lane expressway from Stockhold to Arlanda, just off the main route to the university town of Upsala, is under construction and, when completed, SAS officials hope the present 35-min. driving time to the airport from Stockholm can be shaved by a considerable margin.

SAS also has had to bear the cost of a $14-million engine overhaul facility, Lintawerken, near Bromma to handle the DC-8s' JT4s and the Rolls-Royce Avons used on the airlines 13 twin-jet Sud Caravelle medium-range jet transports. Lintawerken, which first opened its doors last spring and "really began rolling around Oct. 1," also handles most of the major electronics maintenance and overhaul for the airline.

Equipped with two engine test cells and the most up-to-date overhaul tooling available, Lintawerken is in the market for more work from other airlines using the Avon and the JT4.

At present, the shop is overhauling between nine and 10 JT4s per month and plans to hit a rate of between six and seven Avon 527-20s per month in the near future. Lintawerken began working on the JT4 from the moment it opened its doors but is just beginning to assimilate the Avon. Previous Avon overhauls had been handled by Rolls-Royce in England.

When Lintawerken began operation, all available technical talent was needed to work on the jet powerplants, and Sabena Belgian World Airlines has been handling overhauls for SAS's piston-engine fleet for the past six months on a temporary basis. Whether this work will remain at Sabena or be brought back and handled by Lintawerken is still being discussed.

"We've told them that we'll leave our piston engines there (in Brussels) if they will give us some of their Avon overhaul," according to Knut Hagrup, SAS vice president for operations, maintenance and overhaul. "Otherwise, we'll have to pull them back to Lintawerken."

In discussing the need to support maintenance bases in three different locations, Hagrup says the jets have created new problems.

"In the old days," he explains, "it was relatively simple. Norway took care of our DC-3s, Sweden had the DC-6s and Denmark the DC-4s. Then we started selling the DC-4s and bought DC-6Bs. It was cheaper, of course, to send DC-6B's to Bromma since the older 6s were already there.

"Next, we bought DC-7s and, again, the most economical place to go was Bromma. Norway was all right, since we put the Convair 440 maintenance there when we began to phase out the DC-3s, but Copenhagen ended up primarily doing work for foreign carriers."

Because of this, it was decided that work could no longer be split among the three countries by types of aircraft, and the maintenance was broken up between Copenhagen (airframes) and Stockholm (engines) with the arrival of the Caravelles and DC-8s.

Hagrup and other SAS officials also hope that some of the modification costs of the DC-8 can be recouped once the aircraft have been put back into operation. Lessening of the drag by thinning the leading edge of the wing, Hagrup estimates, will save approximately two tons of fuel on a transatlantic crossing. "So, taking in the fuel savings, and if we can sell the additional payload, we can pay for the modification within a few years."

Modification of the seven DC-8s will be divided over two winters, beginning this year, to avoid any possibility of having an aircraft out of service during the peak summer seasons. Modification of each aircraft will require approximately four weeks.

SAS also will handle the leading-edge modifications for the three DC-8s operated by Swissair, its jet-equipment-pool partner. The Scandinavian carrier, however, abandoned earlier plans to install additional wing tanks during the past winter as an interim measure, while Swissair, finding itself unable to compete on a nonstop transatlantic schedule because of the increased fuel consumption, made the modifications on its DC-8s.

SAS officials say they have been able to make the flights to New York nonstop because they fly a more northerly route than Swissair where the winds are more advantageous and, therefore, decided against installation of the wing tanks.

A Swissair official says the wing tank fixes "as expected . . . have not completely solved the range problem. This will be achieved only with the modifications planned for next winter."

If Guest Aerovias should purchase a DC-8, its overhaul, in all probability, also will be conducted by SAS. If it does not and, even if it should continue to fly the mid-Atlantic with piston equipment, its future relationship with SAS seems problematical.

The Scandinavian carrier, in response to a request for help in establishing Guest on the Atlantic route, has provided loans, helped it with equipment and acted as the airline's general sales agent outside Mexico.

"We knew," an SAS official says, "that it would be hard for them to compete on the mid-Atlantic without jets, although their local service has been good. It's now come to the point where they must get jet equipment.

"If they don't solve their problem [finding funds to finance such equipment], we may lost quite a bit. If they do, the situation should change."

In its venture with Thai Airways International, SAS has purchased a "very minority" stock holding and provided technical assistance, crews and aircraft. Thai has purchased several DC-6Bs from the European airline. Thai technicians, crews and administrators are being trained to take over the responsibility of the operation, and SAS officials say the airline's future looks good.

Its Far Eastern network includes routes from Bangkok to Calcutta, Singapore, Saigon, Hong Kong, Taipei and Tokyo.

When Thai gets on its feet, it will relieve a financial and technical drain on SAS and, eventually, begin pumping money back into the organization in the form of payments on loans and as interest on stock purchases.

(This is the first in a two part series dealing with SAS. The conclusion will follow in the Mar. 27 issue of AVIATION WEEK.*)*

Transcontinental Routes Awarded To Strengthen Delta and National

By Robert H. Cook

Washington—National Airlines and Delta Air Lines became transcontinental carriers last week under a Civil Aeronautics Board decision which is a clear indication that the Board will continue to emphasize balancing airline competition by strengthening the route systems of the smaller trunklines.

The Board's decision in the Southern Transcontinental Service Case creates two new routes linking Florida and the Southeast area directly with California. National's system was extended from Houston, Texas, to San Francisco via Las Vegas and to Los Angeles via San Diego. Delta's route system was extended to the same points from its present western terminal point of Dallas/Ft. Worth.

All existing interchange agreements over the southern transcontinental routes have been terminated by the CAB order, which authorizes the first single-carrier service connecting Florida and the southeast with the West Coast. Interchange agreements previously in effect included: Continental-American, Delta-American, National-Delta-American and Braniff-Trans World Airlines.

These routes were awarded to other airlines in the case:

- **American Airlines** gained a new route segment connecting El Paso, San Antonio and Houston, Texas.
- **Eastern Air Lines** was awarded a new route segment between Ft. Worth/Dallas and Tampa, via the intermediate point of New Orleans.
- **Continental Air Lines** was given a new route segment between Houston

and Los Angeles via San Antonio, El Paso, Tucson and Phoenix.

Noting that it generally agreed with the recommendations of Examiner Edward T. Stodola (AW June 27, 1960, p. 39), the Board emphasized the need for two airlines along the southern transcontinental route but also cited the problem of separating regional area service needs from the desired coast-to-coast services.

The selection of National to operate one of the two new transcontinental routes, CAB said, was made because of the carrier's need for route strengthening, coupled with the fact that award of the route may be the last opportunity to expand the airline's system to a point where it can sustain long-range jet operations.

Delta's route was granted on similar grounds, with the CAB adding that the selection of either American or Eastern for the new route would have deprived Delta of a significant share of revenue earned from its southern transcontinental interchange service and would also weaken its competitive strength.

In order to establish separate southern transcontinental routes, the Board restricted Delta from providing any single-plane service between any point in Florida south of Orlando and any point west of Ft. Worth. In this manner, Delta and National will divide the traffic moving between the Southeast and the West, the Board said, with Delta responsible for improving the West Coast service from the Northern Florida and Alabama/Georgia area and National providing service in southern Florida.

Service to intermediate points between Houston and the West Coast, including such stops as San Antonio, El Paso, Tucson and Phoenix, more properly requires a regional, rather than a transcontinental type of service, the Board said. Authorization for both American and Continental on a Houston-to-the-West route should still provide National with an additional $41 million in annual operating revenues over the transcontinental route, while Continental should realize an estimated $7.8 million serving Houston and the intermediate points, the Board said.

In contrast, CAB said Dallas has long been provided with unrestricted service by American to most of its important markets to the West and does not require competitive service to Lubbock, Amarillo or Phoenix. The Dallas-Phoenix market is not large, the Board pointed out, and produced only about 9,500 passengers in 1959. The Board did, however, comply with a request by Dallas for single-plane service to Las Vegas, pointing out that travellers were forced to use several different airlines and routings to reach the city. The authorization of Delta to provide this service also contains a restriction against continuing Dallas flights beyond to San Francisco.

The same restriction was placed on National on its Houston service, the Board said, to prevent any dilution of local traffic between Las Vegas and San Francisco. In a similar manner, CAB also denied Examiner Stodola's recommendations that American, Delta and National be granted an additional route segment connecting Los Angeles with San Francisco.

Reviewing its reasons for selecting Eastern over Braniff for a Dallas-New Orleans-Miami route, CAB called attention to Eastern's decreasing financial strength and the increased competition the airline will face from a merged United and Capital Airlines. Although recommended by the Examiner for the route because of its need for more long-haul, high-density traffic markets, Braniff would suffer less traffic diversion from its present route system than Eastern, and should not be chosen for the Florida route, the Board said.

CAB expressed concern over Eastern's plight, noting that "we are convinced that the competition between carriers required by the [Federal Aviation] Act cannot be preserved if the economic position of any of the trunks, whether classified as a Big Four or a non-member Big Four, is permitted to deteriorate in relation to other trunkline carriers with which it is required to compete. Maintaining the strength of Eastern is of substantial importance in our ultimate goal of preventing imbalance in the size of the carriers that are expected to compete with each other."

In this area, CAB also favored a regional type airline service, pointing out that more than 209,000 local and connecting passengers were carried over the Dallas-New Orleans segment in 1958. While much of this traffic has been interchanged in the past and will now be carried over the transcontinental routes of Delta and National, the Board concluded that the limitation on intermediate points on Delta's route west of Texas will result in a continuation of connecting traffic flow through Dallas and Ft. Worth.

Northwest Orders 720Bs

Northwest Orient Airlines has ordered six Boeing 720B turbofan-powered transports and taken option on six more.

Price tag of the initial six with spares is $36,772,000. The sale, under negotiation for the past year, has been slowed by Northwest's strike problems. Although the order has just been announced, a Northwest 720B is nearing completion on the Boeing line.

Delivery of the medium-range jets is scheduled to begin in June, with first service in July. Northwest plans to use them in service to large intermediate cities between the U. S. coasts. The airplane, however, has ample range for nonstop transcontinental service and West Coast-Hawaii service, Northwest said. Configuration will be 38 first-class and 69 tourist seats.

Class Rates Are Final For 12 Local Airlines

Washington—Twelve of the 13 local service airlines began operating this month under class subsidy rates, retroactive to Jan. 1, with only Central Airlines refusing to accept the new Civil Aeronautics Board formula.

Central will present CAB with arguments against accepting class rates later this month. Originally, three local airlines in addition to Central notified the Board of objections to the new rates, but all but Central subsequently decided to accept them.

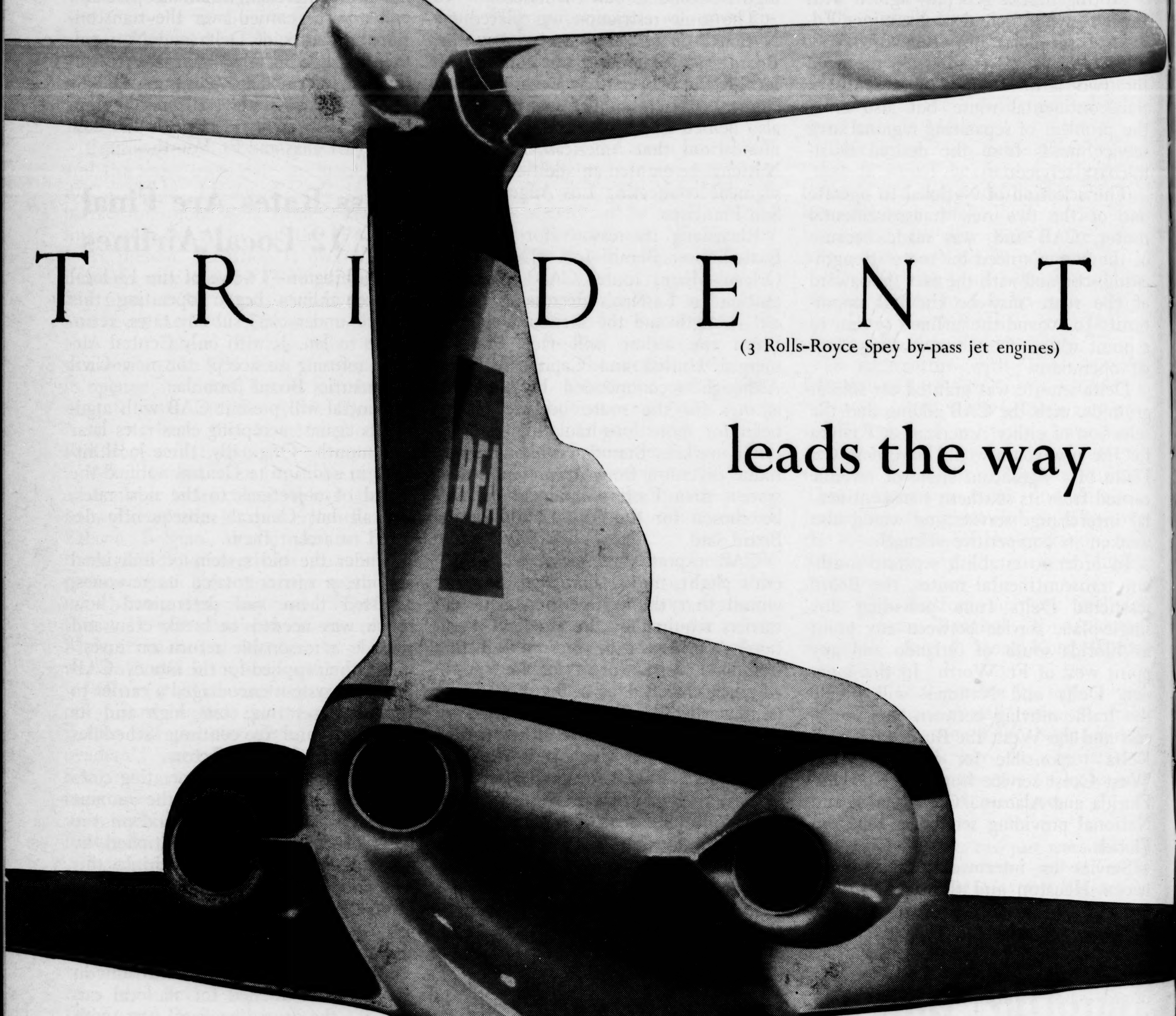
Under the old system of individual subsidy, a carrier totaled its revenues, adjusted them and determined how much was needed to break even and provide a reasonable return on investment, then applied for the money. CAB feels this system encouraged a carrier to keep its operating costs high and its fares low, and to continue schedules not justified by load factors.

Under the class rates, operating costs have no direct bearing on the amount paid as subsidy, which is paid on the basis of the class rate multiplied by available seat miles. CAB thinks this will encourage carriers to watch costs more closely since money saved by more efficient operations becomes profit and also reduces need for subsidy.

Operating costs affect subsidy only in that they are totaled for all local carriers for the preceding fiscal year, with certain adjustments, and used as a base to determine the class rate for the following calendar year.

The class rate takes the form of a sliding scale. A given density factor—tied to the daily volume or revenue plane miles at a station—has a corresponding rate which, multiplied by total available seat miles, gives subsidy. The scale varies from a maximum of 3.11 cents for 300 revenue plane miles per station per day to 1.90 cents for 600 miles per station. Thus, as traffic volume increases, the subsidy per available seat mile decreases.

The second part of the formula is a profit-sharing plan whereby the airlines will rebate to CAB 50% of any profits earned between their established rate of return and a return of 15% on investment. Profits in excess of 15% call for a 75% rebate.



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Seaboard Proposing New Cargo Concepts

By L. L. Doty

Washington—Seaboard & Western Airlines will key its future expansion plans to a new route structure concept that would give the all-cargo carrier freedom to serve entire areas where it can create air cargo markets, rather than specified gateways where freight potentials may not necessarily exist.

The plan, which Seaboard calls the area concept, is based on the airline's conviction that no common carrier of freight can ever show substantial profits under the present principles of all-cargo operations. It is a major segment of its over-all program to tap new sources of revenues—including the introduction of a low-fare, no-frills, transatlantic passenger service announced here last week.

Seaboard's President Richard M. Jackson, who conceived both plans, wants the passenger business as "top-off" traffic, the reverse of passenger carriers' use of freight as top-off traffic on passenger flights. Passenger seats, premounted on pallets, would be loaded on the airline's Canadair CL-44 turboprop transports after all cargo had been loaded. Seats would be allocated on a first-come, first-served basis.

Jackson wants the area concept to permit Seaboard to operate into markets where a cargo potential exists, which, he believes, are not always the same markets where a passenger traffic potential necessarily exists. He charges that it is archaic thinking to reason that an all-cargo carrier's routes must be patterned after the routes of passenger carriers.

Eliminate Gateways

Seaboard now serves Shannon, Ireland, on its transatlantic route, with one segment branching north to London and Frankfurt and a second south to Paris and Zurich. What Jackson seeks is a series of routes that will reach into areas within Great Britain, France, Germany and Italy without the restrictions of a specified gateway.

Since such an operation would entail the transportation of a substantial amount of Fifth Freedom traffic, Jackson is prepared for strong resistance on both sides of the Atlantic. But he claims that all-cargo carriers—foreign and domestic—can survive only if this route concept is brought into play.

Jackson sees the ideal all-cargo carrier operation as a commercial trade system similar to the pattern set by Yankee clipper ship captains during the 19th century. He cites the "triangle" trade route on which ships carried molasses from the West Indies to New England, rum—made from the molasses—from New England to Africa where it was traded for slaves who were transported to the West Indies to produce the molasses.

Jackson, 42, who was named president and chairman of the board of the carrier last August, disclaims any suggestion that his move into the passenger field infringes on the airline's role as an all-cargo carrier. Emphasis on cargo will always be stressed, Jackson says, if only because revenues from one cargo pallet will yield $3,200 compared with $1,600 for each passenger pallet.

In fact, Seaboard is filing its passenger fares as a cargo rate—3.8 cents per mile. If the International Air Transport Assn. traffic conference refuses to accept the rate as a cargo rate—and the IATA enforcement office has already advised Seaboard that it is believed to be in violation of IATA resolutions—then the carrier will simply point out that it has no vote on passenger fares in the conference and is, therefore, presumably free to set any passenger rate it wishes.

Seaboard lost its right to vote on passenger rates when the IATA executive committee decided to separate conference voting on cargo and passenger rates (AW Sept. 19, p. 39).

In addition, foreign governments will probably disapprove the rates on grounds that they would be highly competitive with scheduled passenger carriers. Jackson thinks otherwise. He feels that his program will not divert traffic but will open an entirely new market which passenger carriers, with their higher fares, are unable to reach.

As a first step toward inaugurating the program, Seaboard has filed a petition with the Civil Aeronautics Board asking that it be granted an exemption to carry passengers for an experimental period of one year.

Convair 990 Changes

Convair will return its number one 990 aft-fan-powered transport to the factory next week for modifications to the outboard pylons. Other modifications planned for the series include decreasing elevator control forces.

The outboard pylons on the 990 are longer than the 880 because the powerplant is mounted farther forward and too much flexibility at certain power settings and speeds resulted in a limited cycle pod oscillation. The pylons will be shortened 28 in. to increase stiffening. Flight tests will be resumed at the end of April.

The elevator control changes in the internal linkages are necessary because test flights have indicated difficulty in stalling the aircraft with the center of gravity in farthest forward position.

Under the plan, no reservations would be accepted before six hours in advance of scheduled flight departure time, and passengers would be accepted in the order in which they checked in. Number of seats available would depend entirely on the amount of cargo loaded prior to six hour period.

Fares would range from $133 one-way New York to London, to $145.80, one-way New York to Frankfurt. Rates are comparable to rates on charter flights. Passengers would be carried only on the airline's CL-44 equipment, which will be introduced in transatlantic service July 1.

No meals would be served. According to Jackson, passengers would be provided only with a "seat, window and toilet facilities." The CL-44 will be equipped with 10 pallets, each capable of carrying 6,500 lb. for a total transatlantic gross payload of 65,000 lb. Passenger pallets will contain 12 seats with a 32-in. pitch mounted three abreast on either side of a central aisle. Pallets will be locked to the plane's floor to resist a force of 9g.

Here are the effects Jackson feels the proposal would have on air transportation if adopted:

- **It would serve the public** interest by providing a cheap form of transportation between the U. S. and Europe previously available in limited quantity on charter flights. Jackson visualizes students and low-income groups making full use of the low rates.
- **Economically,** the extra income drawn from the passenger service would transform Seaboard's operation from a marginal business to a profitable enterprise. With a break-even load in cargo on a given flight, each passenger carried would represent a profit to the airline. Seaboard has recently signed a $3-million contract with Military Air Transport Service which provides the carrier with a minimum of 350 tons of traffic per month for one year, beginning last month.
- **Additional revenues** from passengers would permit the all-cargo carrier to serve cargo markets that are normally unprofitable but which have a profit potential once the market is developed through actual service.

Seaboard handled 2.2 million lb. of traffic in January and 2.3 million in February. At the present time, the airline is certificated to operate a scheduled service across the Atlantic carrying cargo, commercial air-mail and military surface mail. The airline operates subsidy-free.

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PanAm Divestiture Portends Wide Effects

By Glenn Garrison

New York—Possible far-reaching effects of a Mar. 8 court decision that Pan American World Airways should divest itself of Panagra stock include a thorny future question for the Civil Aeronautics Board as to whether W. R. Grace & Co. should control Panagra.

If the decision stands, it also will probably mean a reshaping of the U. S. flag competitive picture between this country and South America, particularly the west coast of South America. A Panagra free to press for routes into the U. S. could effectively add a third independent U. S. operator in the market. The alleged restraint of Panagra by Pan American has prevented Panagra's development of such routes, the court found, and on this basis the divestiture is indicated.

Grace, operator of a steamship line that parallels some of Panagra's routes in South America, owns 50% of the airline's stock, with Pan American holding the other 50%. The three companies are defendants in the lengthy anti-trust suit instituted by the U. S. Justice Dept. in 1954.

Late last week, Pan American was scheduled to appear before U. S. District Court Judge Thomas F. Murphy here to seek more time in which to show cause why a final decree in the case should not provide for the stock divestiture. Judge Murphy has handed down an opinion which:

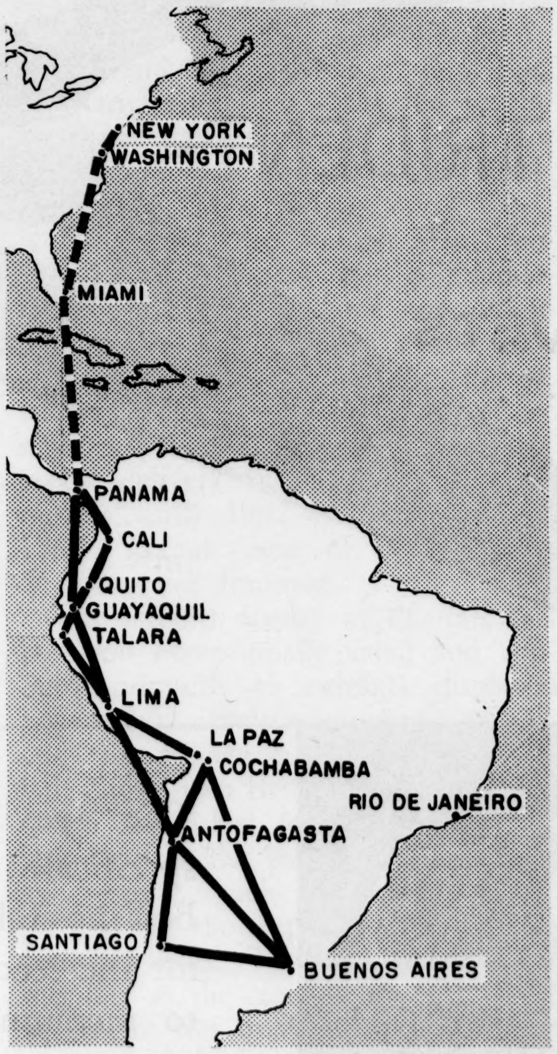
- **Dismissed government charges** that Pan American and Grace illegally conspired to restrain and monopolize trade between the U. S. and South America by forming Panagra under joint ownership in 1929, and by agreeing to a division of territory between the two airlines. Under the agreement, Pan American was to develop traffic on the east coast of South America and Panagra on the West Coast.
- **Found that Grace's ownership in** Panagra does not violate antitrust laws, and that Grace and Panagra have not been guilty of any antitrust violations.
- **Called Pan American's restraints** against Panagra and "continued determination to suppress the extension of that airline to the United States" an antitrust violation that would seem to require divestiture by Pan American.
- **Deferred to the primary jurisdiction** of CAB the question of Grace's control in the management of Panagra, and also the legality of joint advertising, sales, offices and the like between the two airlines.

While Pan American has no official comment on the decision, most observers feel sure the airline will appeal. The Justice Department too, is likely to appeal the finding that Pan American and Grace were not violating antitrust laws in their Panagra combination and the division of territory.

But it seemed unlikely that the case would drag on for additional years. Reason: next stop on appeal is the Supreme Court of the United States, under a special expediting statute covering civil antitrust cases involving the government. Estimates by legal observers set next fall as the probable time for hearing by the Supreme Court, assuming the appeal or appeals take place and the high court agrees to hear them.

Next immediate step is the show cause procedure by Pan American and, assuming Judge Murphy's opinion is unchanged, a decree will then be entered ordering Pan American to divest.

Many questions arise as to how the divestiture would be carried out. If, for example, the Pan American shares were sold to various parties, Grace would effectively control Panagra. Conceivably, Grace could increase its own holding.



PANAGRA routes could be extended to United States if divestiture of Pan American half-ownership takes place. PanAm has opposed extension. Panagra routes now end at Panama, with interchange services (dotted line) providing link with United States.

A vital question for a Panagra free from Pan American restraining control would be the matter of routes into the U. S. Since 1938, according to the court, the Grace half of Panagra's board of directors has sought to file application with CAB for such an extension. Panagra's present routes stop at Balboa, Canal Zone, and service northward is provided by interchange arrangements. Panagra crews operate Panagra aircraft from Balboa to Miami, but the flights are Pan American interchanges. From Miami to New York, Panagra equipment is operated by National Airlines' crews on National interchange flights.

But, the court said, Pan American board members of Panagra have been instructed that "it would not be in the interest of [Pan American] stockholders for [Panagra] directors to authorize an application by Panagra to extend north of the Canal Zone in competition with Pan American."

However, in 1957, Grace, on behalf of Panagra, filed applications for routes to Miami, New York and the West Coast of the U. S. CAB action has been suspended pending outcome of the antitrust suit.

With Braniff International Airways operating between Miami and the Canal Zone and into South America, a Panagra route to Miami would mean a three-carrier situation between Balboa and the U. S. This has raised the question of a possible merger between Panagra and Braniff.

But a spokesman for Grace said last week "we have no intention of merging Panagra with Braniff."

In the court's opinion, Pan American's successful blocking of Panagra's extension to its own terminal in the U. S. constitutes ". . . an unlawful exercise of the power [Pan American] had to exclude Panagra as a competitor in the United States-South American market, and thereby maintain its virtual monopoly position over that market at least until the entry of Braniff in 1948. Thereafter and to date, [Pan American] remains the dominant carrier in that market and maintains its power to participate in substantially all United States origin or destination traffic carried by Panagra through its continued suppression of a Panagra-United States extension."

Pan American's position, according to Judge Murphy, is founded on a false position: "Panagra is not part of the Pan American system except to the extent that it is reduced to that status through the subjugating exercise of Pan American's negative control over its destiny . . . . If Panagra were wholly owned by Pan American we have no

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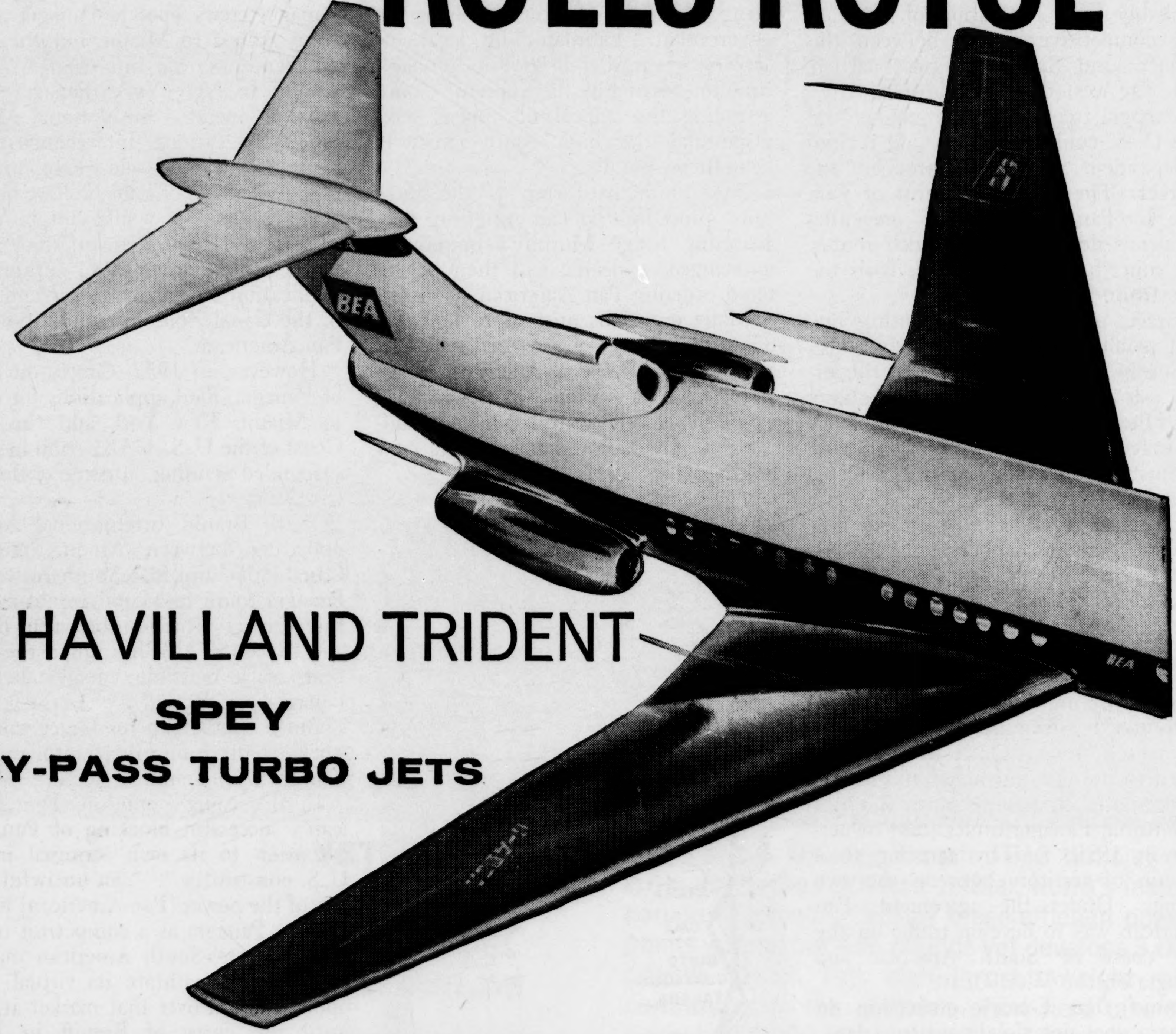

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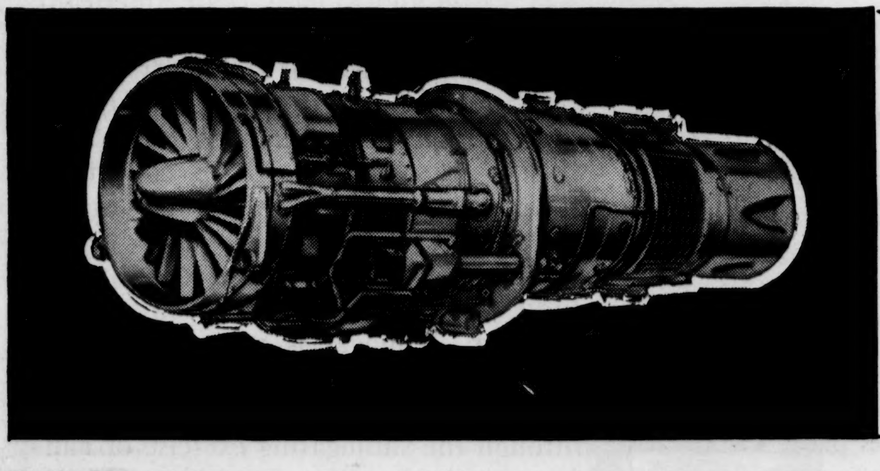

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doubt that its extension to a United States terminal would have been effected decades ago."

The government's case against Panagra, which involved charges of unlawful acquisition of stock in competing airlines and subsequent restraint, price fixing, and impeding the development of Braniff competition, relates "to matters in the distant past or minor incidents in a highly competitive field," the court found. Of the charges of impeding Braniff, the court said government evidence "seems to picture Braniff, an experienced carrier, as an innocent tyro in the air transportation business, being buffeted and barked at by Panagra. The government showed that even though Panagra was helpful and courteous to Braniff in its initial survey flights . . . [Panagra] became pigheaded and uncharitable when it insisted upon being paid for the use of its facilities and supplies and services. We get the impression that Braniff wanted everything for nothing, including routes not certificated."

The court added that Braniff gets its fair share of South American traffic, doing half as much business as Panagra, after being in the market only 10 years as against Panagra's 30 years.

Another Justice Dept. charge was that there is competition between Panagra and Grace for passenger and cargo traffic. Judge Murphy found no evidence that the air and sea passenger markets are interchangeable. Air travel, he noted, is quick, efficient and functional transportation for passengers over long distances. Steamship companies, on the other hand, "cater to those who have the leisure and inclination for a sea voyage."

The same reasoning applies to cargo markets, the court found, in that the markets are different. Regarding testimony that the air cargo field is expanding and may in the future present an interchangeable service, Judge Murphy held that the volume of cargo carried by Panagra compared with Grace was "minuscule." All-cargo air transportation is in an experimental stage, the court said, and most of the operations are marginal at best.

Even if Grace had been shown to compete with Panagra, the court found, this would not mean a violation of antitrust law. Grace has not restrained or monopolized trade in this connection. If anything, Grace was the only one of Panagra's two partners that has persistently attempted to improve its service and extend its routes to the U. S.

Regarding the charges of conspiracy against Grace and Pan American, Judge Murphy said the only agreement between the two companies that approaches conspiracy was their understanding that the two airlines would not parallel each other's routes. This, the court held, was not a conspiracy to monopolize and restrain trade.

Joining of Grace and Pan American to use their complementary facilities was a natural and mutually advantageous combination, the court found, and an economically sound arrangement for the establishment and development of American commercial aviation on the west coast of South America. Grace had branches, agencies and steamship facilities that could be used in the new airline operation; Pan American had the technical aviation skill which Grace then lacked.

B. 152 Is Completing Flight Test Program

Leipzig—Second prototype of the Baade B.152 swept-wing four-jet transport is completing its flight test program at Veb Flugzeugwerke in Dresden, according to East German officials at the Leipzig Technical Fair.

Roland Schumann, director of Technocommerz GmbH, of Berlin, the East German sales organization responsible to the government for all aircraft sales and related products, said "production of the jet transport is expected to go ahead as originally planned."

First prototype B.152 crashed in the spring of 1959. At last year's Leipzig exhibition, Heinrich Rau, minister of foreign and inter-German trade of East Germany, announced that the second prototype was expected to be ready for export around the middle of 1961 (AW Mar. 21, 1960, p. 67).

However, in the opinion of a number of observers here, it is problematical whether the original production program can be met. Even the East German airline, Deutsche Lufthansa, which hopes to introduce its first jet services with the Baade B.152, does not expect delivery of the first production models until 1962 or possibly early 1963. Actual cause of the apparent delay was not disclosed.

The aircraft display at the fair this year was exceptionally small and confined primarily to exhibits displayed previously. Technocommerz officials said that foreign participants, particularly those from Britain and West Germany, had asked for more space this year than in the past and that, so far as possible, such applications were granted at the expense of the East German hosts. Technocommerz cited this fact as the reason why Veb Flugzeugwerke was unable to display even a section of the B.152.

As it did last year, Veb Entwicklungsbau of Pirna, which is responsible for design and development of turbines in East Germany, featured a model of the Pirna 014, which powers the B.152. The firm also exhibited a model of the Pirna 130-hp. 017 gas turbine designed as an auxiliary powerplant for various industrial applications and which may be used later on small aircraft (AW Apr. 4, p. 94).

Omnipol, Ltd., of Prague, the Czech foreign trade organization, displayed the only two aircraft seen at Leipzig this year—an improved export model of the Czech Morava L200A four-to-five seat utility transport and the Z 326 Trener Master, a two-seat tandem, low-wing plane.

According to Omnipol, a new-seat helicopter, the Z-35, designed specifically for postal services to remote areas, is under development. However, details of the new model, which reportedly is a modified version of the Czech multi-purpose HC-102 Heli Baby helicopter, were not available.

Task Forces Prepare For Aviation Studies

Washington—Two Kennedy Administration aviation task forces were beginning to organize last week to map national aviation goals and analyze the air traffic control situation.

Extensive review of several past studies on aviation, such as the Curtis and Harding reports, will be the initial objective of the committee on national goals, headed by Fred M. Glass, an executive vice president of the Empire State Building and a former member of the Harding Committee and of the Reed Committee which conducted a study of MATS.

Primary purpose of the task force is to determine the functions and responsibilities of both military and civilian aviation as a basis for achieving the maximum practical use of the nation's total aviation industry for the coming decade. Labeled Project Horizon by the FAA, this committee expects to make its first recommendations within the next four months.

Members of the committee have not been chosen yet, but Glass has indicated he expects to select the members this week.

The White House-appointed committee on air safety is being headed by Richard R. Hough of Cleveland, Ohio, and will also submit a report on its findings to FAA Administrator Najeeb E. Halaby within the next few months. Its task will be to analyze the present system of air traffic control, the needs of the users and the status of all research and development programs in this area.

To provide scientific guidance for this study, Halaby and Dr. Jerome B. Wiesner, science adviser to the President, are also forming a scientific advisory group under Dr. Jerold Zacharias, professor of physics at the Massachusetts Institute of Technology.

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SAS Caravelle Modifications Proposed

Copenhagen—Danish Directorate of Civil Aviation has recommended a number of basic operational and instrument alterations, including modification of the drum-type altimeter, for the Sud Caravelle in particular and jet transports in general, following an investigation of a Scandinavian Airlines System Caravelle crash during a low approach to Ankara's Esenboga Airport.

The report, made after an investigation in cooperation with the Turkish Department of Civil Aviation, said the official cause of the accident on Jan. 19, 1960, that took the lives of all 37 persons aboard, could not be determined "due to lack of conclusive evidence."

In the bulk of the text, however, the investigators said that "under the prevailing circumstances of high workload a reading error of 1,000 ft." on the drum-type altimeter "may have been made by the crew but not noticed. Such error is known to have been committed during flight training in the simulator as well as in the air."

Only one of three altimeters aboard the aircraft was a drum-type but the captain, who had control of the plane at the time of the crash, was relying primarily upon the latter unit. "Since the face of this instrument is new," the report said, "the possibility of a misreading of 1,000 ft. cannot be precluded since the actual experience in reading it must be said to have been limited at the time of the accident."

The investigators also noted that the Caravelle encountered mixed rain, snow and low ceilings on the approach which the crew may not have expected since no mention was made of such conditions in the forecast and they did not prevail over the airport itself. They concluded:

"The reported as well as the actual weather at Esenboga was above minima. The fact that the actual weather at the crash site was worse than expected cannot be considered a basic reason for descending below the minimum flight altitude but must have taken the crew by surprise, since the actual weather at Esenboga received just before commencing the approach was much better.

"When the aircraft actually came in too low, the combination of bad visibility and the absence of significant landmarks and lights from settlements could seriously have affected the possibility for a corrective maneuver."

The aircraft, an SE-210 with the nationality and registration marks OY-KRB, crashed at a point approximately 6 naut. mi. from the threshold of the runway and about 1,000 ft. to the right of the extended centerline. Impact point was 3,500 ft. above sea level. There had been no indication of trouble by the crew after clearance was received from the tower.

At the time of impact, speed brakes, landing gear and flaps were extended and the engines were under power. The aircraft struck the ground in a normal flight attitude in a 5 deg. nose-up position at an approximate airspeed of 160 kt., continued along the ground for another 2,200 ft. and disintegrated.

The report said that, after beginning a letdown from 12,000 ft., "time from the start of this descent until the aircraft crashed was with great probability between 3.5 and 5 min. The altitude loss of 8,500 ft. gives the rates of descent averaging respectively 2,600 and 1,700 fpm., which means that, if the time needed for start and breakoff of the descent are taken into consideration, the aircraft must at times have descended 3,000 to 5,000 fpm.

"Tests have shown that, even if one calculates with 3.5 min., it is possible to perform such a descent without exceeding limit speeds for certain configurations (landing gear down, etc.), but that descent with a 'clean aircraft' would produce a speed close to the limit of 300 kt."

Directorate Recommendations

Recommendations made by the Danish group after its investigation "are to be part of the continuous work of the civil aviation authorities and SAS towards improving air safety," the report said.

They are:

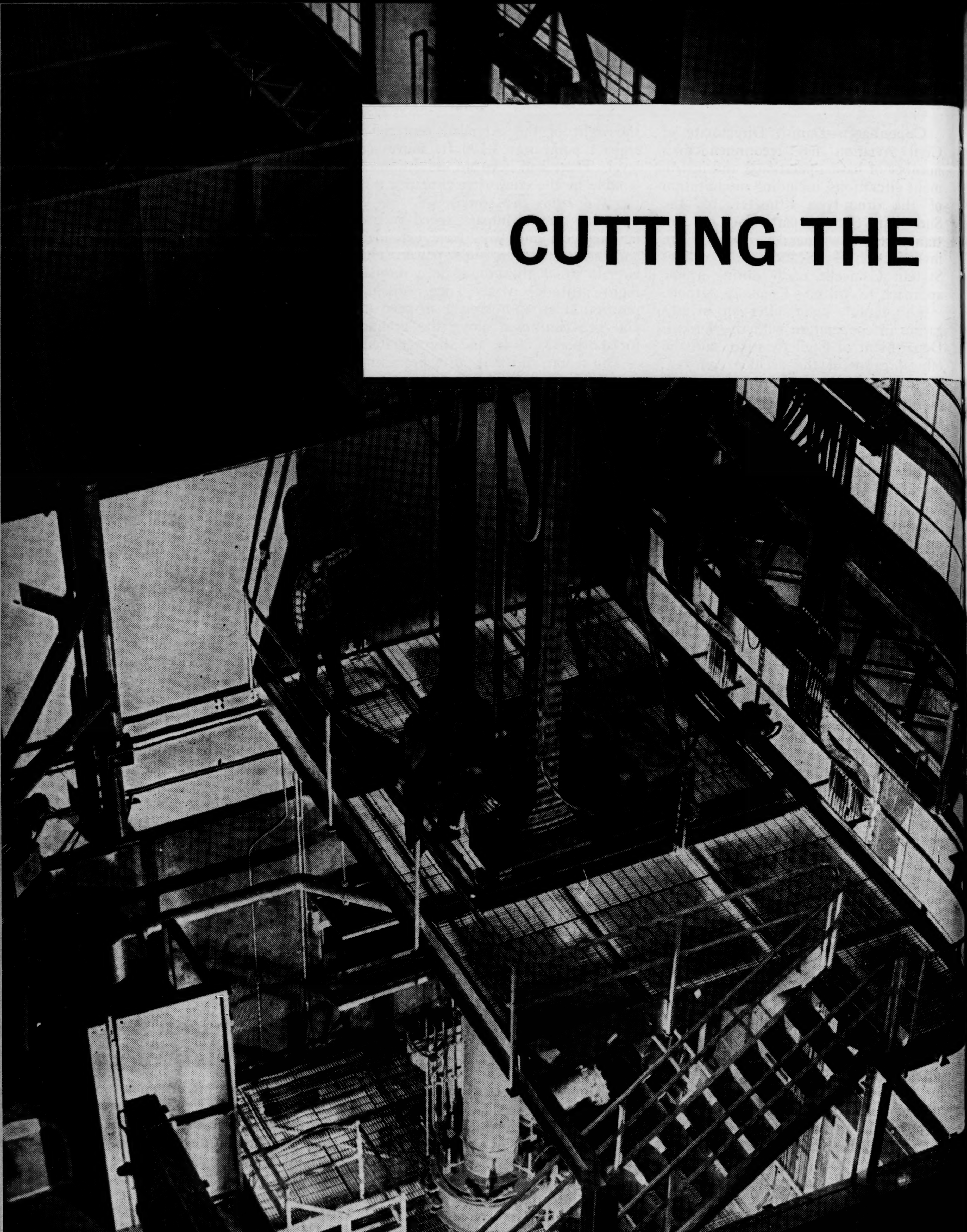
- **Below a certain altitude,** a maximum rate of descent should be established. The report proposed a maximum of 2,000 fpm. below "minimum flight altitude plus 2,000 ft."
- **Crew of the jet aircraft** should receive special training in high altitude approaches.
- **Standardized high-altitude approaches** should be established at all airports with jet operation and relevant approach charts issued.
- **Instrument landing approach systems** should be introduced as soon as possible at all airfields into which jets are operated. At the time of the accident, Ankara ILS was in use "on test" but the glide path transmitter was not operating, and the report notes that an ILS approach may have been made "without the crew knowing or noticing the absence of the glide path signal."
- **Crews should receive** special training in reading "novel instruments."
- **Instrument landing charts** should be supplemented with information regarding airport equipment not in actual operation.
- **"Best possible working conditions** should be established for the cockpit crew by keeping all but primary flying duties away from the captain and copilot and by introducing modifications in the cockpit in order to facilitate crew work."
- **Routine cross-checking** of primary flight instruments should be stressed.
- **Drum-type altimeter** should be modified in order to reduce the possibilities of misreading it.
- **Action should be taken** to eliminate the possibility of misleading indications from the flight director system.
- **"All" servodynes** in Caravelle aircraft should be stripped and cleaned.
- **Modifications** eliminating the possibility of jamming the control columns should be introduced. The report had noted earlier that "certain loose equipment may probably interfere with the free movement of the control columns, mainly due to the fact that the distance between the columns and the cockpit walls varies with the position of the columns. The most likely loose equipment in question are the hand microphone, the torch light, the route manual and the balance computer or, for instance, a Coca Cola bottle."
- **Modifications eliminating** the possibility of smoke in the cockpit due to failure of the motor for the "red hydraulic pump" should be introduced. "Red" system is a standby unit for feeding the flight control servos and all other hydraulic systems of the Caravelle except the artificial feel unit.
- **All drum-type altimeters** should be cleaned.
- **Crew should receive** information on the runway in use as soon as possible during approach.
- **"General switch"** should be modified to prevent inadvertent electrical power loss.

Pan American Asking Bahama Plan Approval

Washington—Pan American World Airways has asked for Civil Aeronautics Board permission to buy 30% of the stock in newly formed Royal Bahamian Airlines, Ltd.

Royal Bahamian was organized last January to operate among the Bahama Islands. Pan American agreed, pending CAB approval, to provide Royal Bahamian with technical and ground services on request in return for a 30% minority interest and the nomination of a Pan American representative to the proposed five-man board of directors.

CUTTING THE C



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AIRLINE OBSERVER

▶ Kennedy Administration has not decided whether it will raise aviation gasoline taxes and impose a new tax on turbojet fuel. Trasury Secretary Douglas Dillon said last week that the new Administration agrees generally with the Eisenhower Administration that aviation fuels should make a bigger tax contribution in view of heavy federal spending for airways, but the situation is still being analyzed. Dillon did urge that current aviation fuel revenues be switched from the highway fund to the general fund where they could be applied against airway costs.

▶ Air Line Stewards and Stewardesses Assn. has affiliated with the Transport Workers Union, but the feud between ALSSA and its former affiliate, Air Line Pilots Assn., continues. ALSSA says it represents stewards and stewardesses on 28 airlines, but ALPA claimed last week that it won the "first in a series" of representation elections in flight attendant groups. The pilot union said 214 of 228 Braniff Airways stewardesses, voting in a National Mediation Board election, favored affiliation with the new Stewards and Stewardesses Division of ALPA rather than with ALSSA.

▶ Some Teamster Union officials will press for establishment of an air transport division within the union during the annual convention July 3 at Miami Beach, Fla. Plans for expansion of existing Teamster membership in the airline industry are expected to be aimed initially at attracting new membership from stewardess ranks.

▶ Early reports indicate that trunkline load factors during the first two weeks of March may have fallen below the 50% level.

▶ American Airlines cites fuel weight reduction as the major advantage it expects to realize from its current conversion of Boeing 707s to turbofan powerplants. Maximum weight savings will be attained on the New York-Los Angeles run, where the aircraft will fly with 10,000 lb. less fuel reserve because of the turbofan's added power and economy. Payload on the turbofan 720Bs is space limited, but the lower fuel requirement can still afford a payload advantage in a hot day operation or against strong headwinds.

▶ Convair Division of General Dynamics is preparing a proposal for a medium-range turbojet transport to compete with the Boeing 727 tri-jet. Prospective airline customers have been told that final specifications for the new aircraft will be available as soon as the current flight testing program on the Convair 990 is completed.

▶ Riddle Airlines, working with Armstrong Whitworth, is reinforcing the fins and elevators of its four AW-650 turboprop aircraft with new ribs, rivets and stringers. Cracking of the empennage skin on the aircraft, which has kept them grounded for the past month, has been traced to transient vibration and buffeting generated by the aircraft's wing wake. Inspections of the modified aircraft will be conducted after each flight until the Argosies have logged at least 100 hr. of flight time.

▶ Soviet Union is expanding its helicopter operations and within a few months expects to add 100 helicopter routes, including 35 in eastern Siberia. The new routes will boost the helicopter route total to more than 200.

▶ British Aircraft Corp. has sold three more Viscount 810s to All-Nippon Airways and one to Lufthansa, bringing total Viscount sales to 429 to 59 different operators. All-Nippon Airways currently operates two Viscount 744s and will take delivery on its initial order of three 810s early this summer. Lufthansa presently has a fleet of nine Viscounts.

▶ Douglas Aircraft engineers estimate that the new Series 50 DC-8s, powered by Pratt & Whitney JT3D turbofan engines and equipped with an extended wing leading edge, will have a 30% greater range than present DC-8 models. An increase in long-range cruise speed is expected to make the Series 50 transport the fastest in intercontinental operations. With turbofans, the aircraft will be able to carry a full payload and normal fuel reserves on non-stop flights up to 5,500 mi. Range can be extended to 5,960 mi. by installing the wing leading edge extensions.

SHORTLINES

▶ **Braniff International Airways** has begun Boeing 707 service from Miami to Asuncion, Paraguay, via Panama and Lima, Peru.

▶ **Civil Aeronautics Board** has assigned Clinton E. Searle of its Bureau of Safety to assist the Argentine government in developing air safety and accident investigation techniques.

▶ **Eastern Air Lines** reports the loss of $3.6 million after taxes last year, the first loss in 26 years. The carrier blamed revenue loss during a 12-day pilot-FAA dispute which disrupted service, effect of the Electra accidents and the general business recession.

▶ **Federal Aviation Agency** will train 20 Air Force men as air traffic controllers in an effort to determine whether FAA should eventually train all military air traffic controllers.

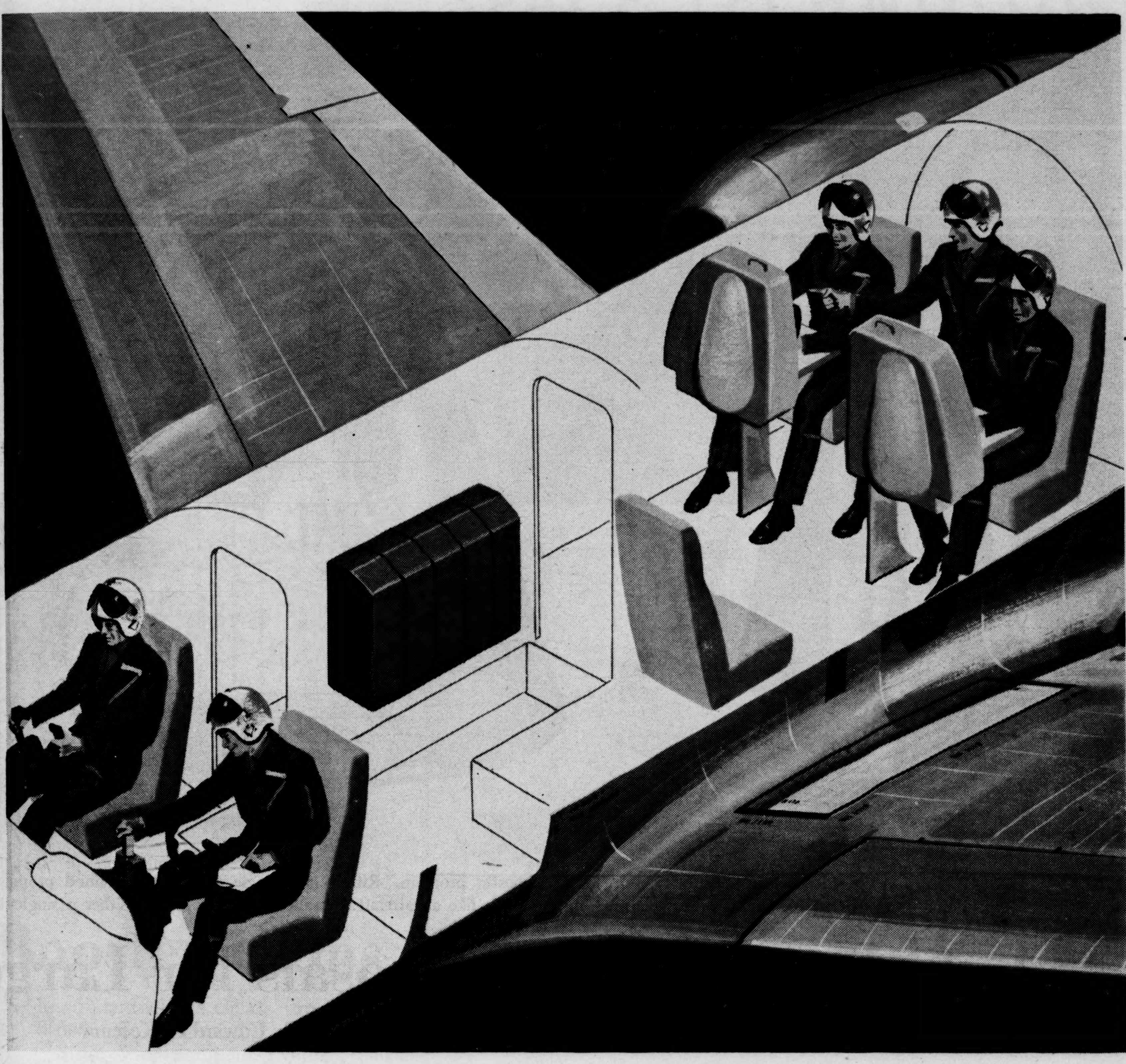
▶ **Federal Aviation Agency** has begun flight testing a new antenna which is part of an anti-collision system developed by Sperry (AW Dec. 26, p. 26). The system is designed to provide for automatic exchange of altitude, bearing and range data between aircraft. Another system designed to reduce collision hazard, the AHSR height radar, was reported successful in initial tests.

▶ **National Airlines** has CAB permission to suspend service to Havana until Mar. 8, 1963. National cited the deteriorating political situation in Cuba for declining passenger traffic. In January, 1958, the airline carried 11,209 passengers on the Havana route, compared with 1,613 in January, 1961.

▶ **Pan American World Airways** has been granted CAB permission to suspend service to Gander, Newfoundland, until Apr. 30, 1963. Trans World Airlines, whose service to Newfoundland had already been suspended, was granted an extension until same date.

▶ **Sabena** has been ordered by CAB to stop exchanging air transportation for advertising, publicity or other services, directly or by using trading contracts, agreements or understandings either written or oral.

▶ **Trans World Airlines** will discontinue using number designations, such as 880, 131 and 331, to identify its jet fleet. All turbojets will be described as Convair, Boeing or Boeing Intercontinental "Superjets."



T-39 SABRELINER: A 540 MPH CLASSROOM

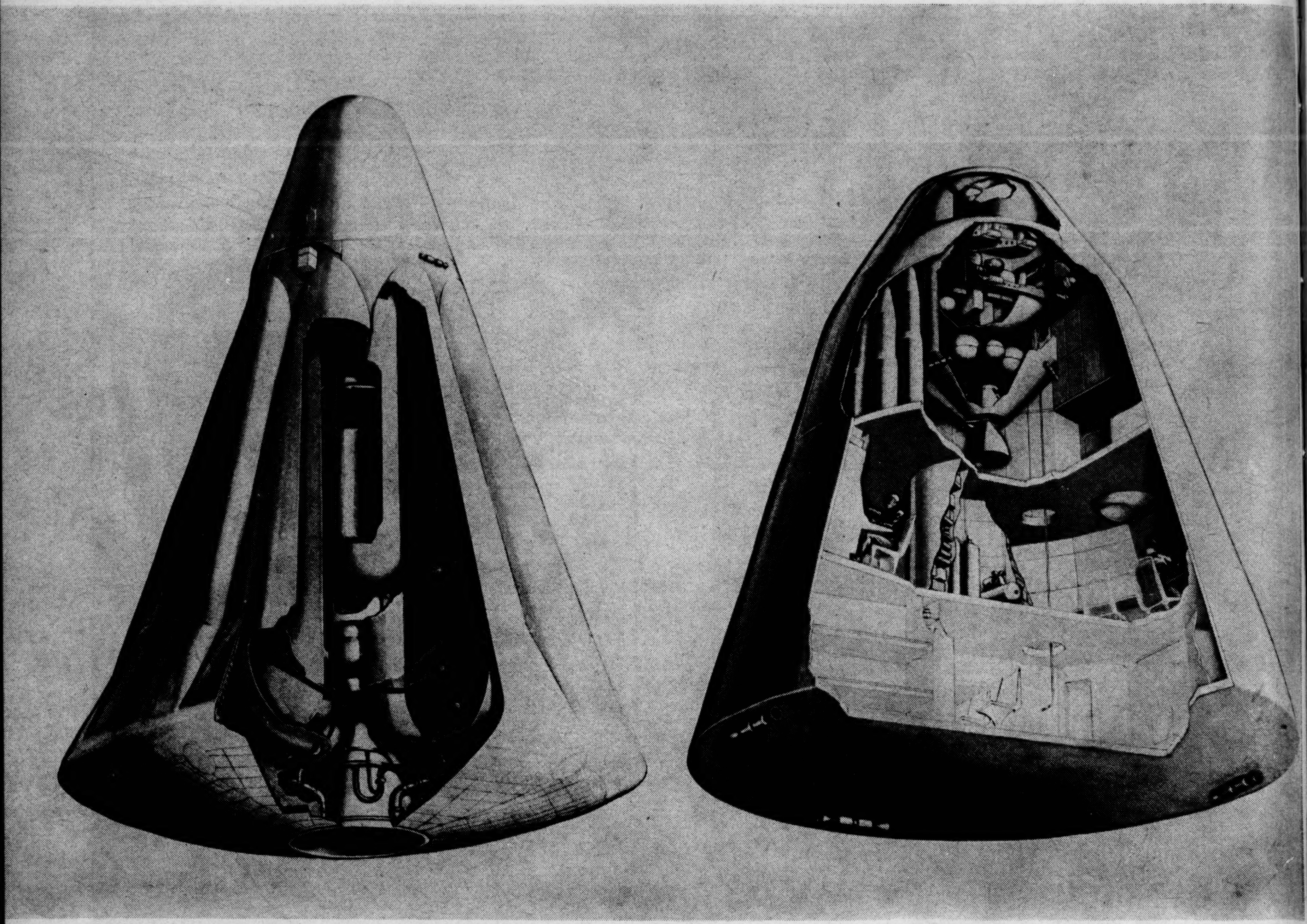
Now the Air Force has a swift, swept-wing jet plane especially fitted for training several student pilots in NASARR radar operations during the same flight.

The plane: T-39 Sabreliner—built by the Los Angeles Division of North American Aviation and already delivered to Tactical Air Command at Nellis AFB, Nevada.

Using the Sabreliner as a radar trainer is another example of how the Air Force gets maximum utility from its equipment at minimum cost. Built originally as a navigation and jet-proficiency trainer, the T-39 is so versatile it can be put to work in many ways by the military services. Its all-round utility and economy of operation truly make it a "workhorse of the jet age."

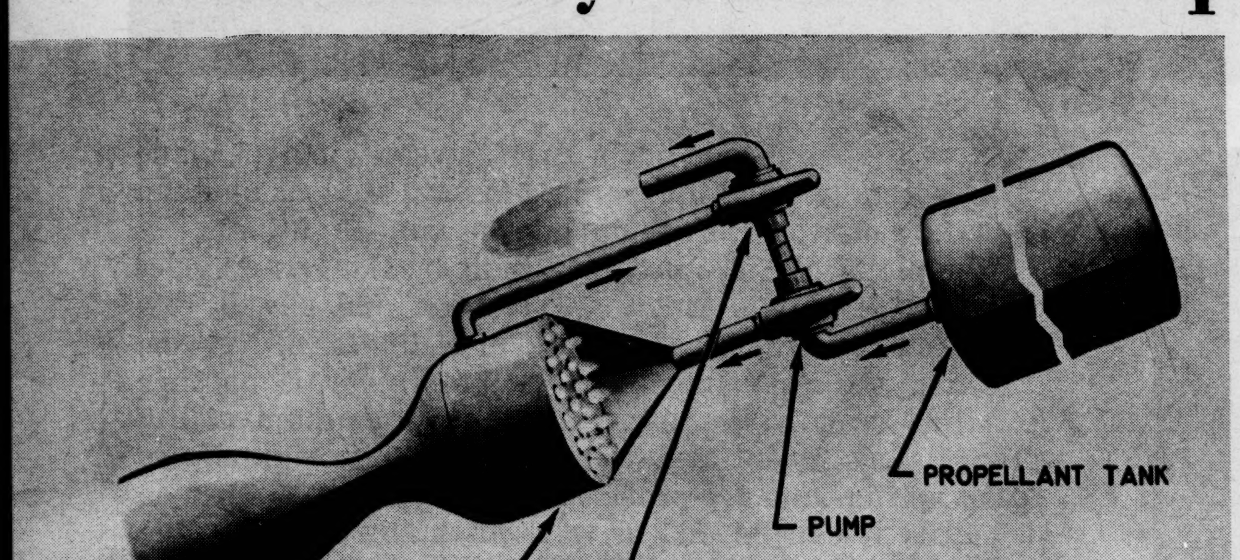
The Sabreliner, with its modern rear-mounted jet engine configuration, cruises at 540 miles an hour at altitudes over 40,000 feet.

THE LOS ANGELES DIVISION OF NORTH AMERICAN AVIATION



DOUGLAS AIRCRAFT is proposing this nuclear transport system for the booster program. Rita-B is a single-stage, self-contained propulsion system without expendable parts so that it could be flown, landed and re-flown like an aircraft. Smaller Rita-A could be either a single-stage

Industry Outlines Proposals for Large



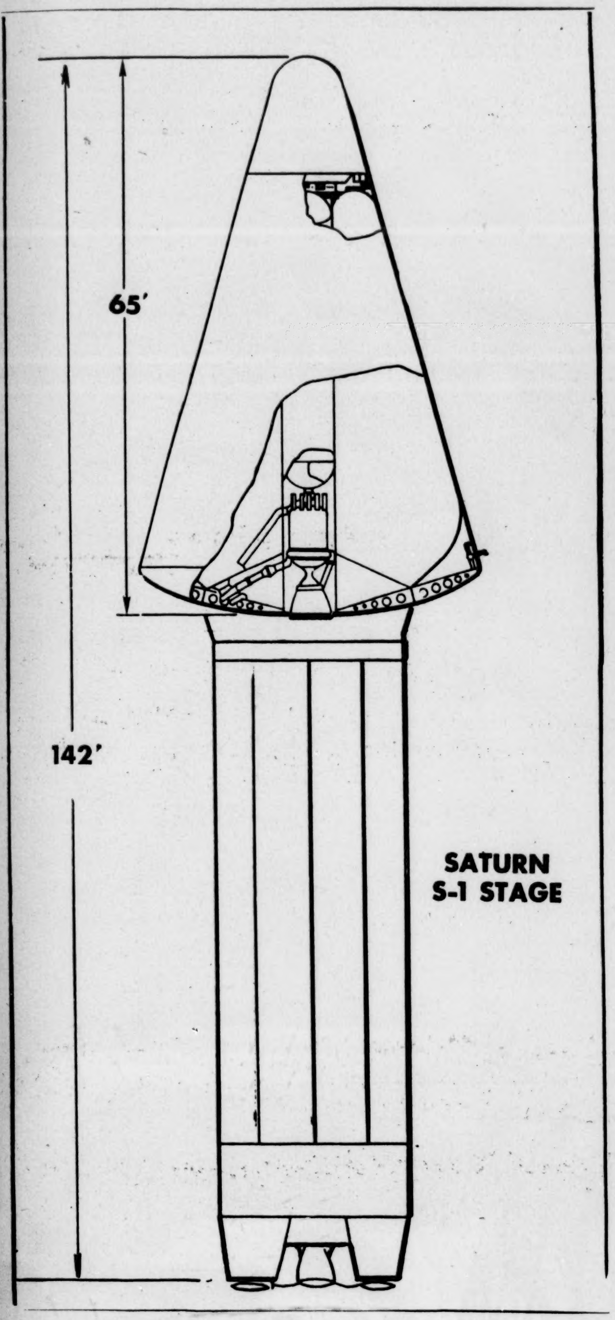
POSSIBLE configuration of a nuclear rocket engine to be proposed by Rocketdyne in the Nerva competition. Company feels that award of a Nerva contract by July would permit a flyable nuclear upper stage to be ready by 1965.

By Edward H. Kolcum

Washington—Kennedy Administration is reaching its decisions on the future of the national space program against the background of a variety of industry proposals that indicate it would be possible to make a long jump in U.S. booster performance within five years, if there were strong White House support and more extensive use of the nation's technical talent.

House Science and Astronautics Committee, reacting to recent Soviet space flights and their obvious effects on the prestige of the United States, has conducted hearings on space propulsion technology that provided a sounding board for a fresh round of industry proposals on future systems (AW Mar. 13, p. 303).

The hearings covered both nuclear and conventional propulsion programs, and they produced clear evidence that industry believes massive U.S. scientific payloads could be launched by the mid-1960s if a decision were reached soon


65'
142'
SATURN S-1 STAGE

system, or the upper-stage for a Saturn S-1 booster.

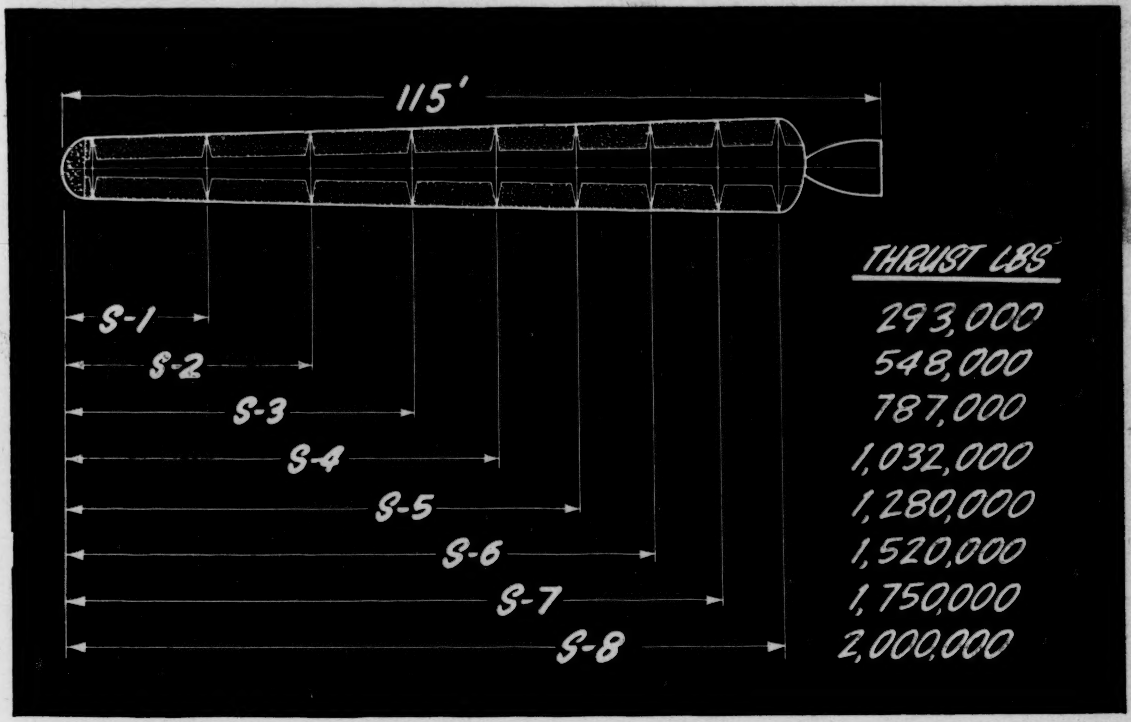
Booster Gains

to substantially accelerate the national booster effort.

Since Vice President Lyndon Johnson has been put in charge of the national space effort, final decisions in this area will have to wait until the Space Act of 1958 is changed to permit him to head the National Aeronautics and Space Council, and until Johnson gets the group organized. When this is accomplished, the alternatives open to the Administration—and to Congress if it decides to move in on the space program—are:

- **Reorient the space program** to advance high impulse launch vehicle systems without changing the Eisenhower Administration Fiscal 1962 space budget of $1.12 billion.
- **Increase the budget** to fund a wider variety of engine systems than are now being considered.
- **Consider the program** an accurate reflection of resources and efforts the U. S. should expend in space, and make few changes.

Industry, National Aeronautics and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THRUST LBS
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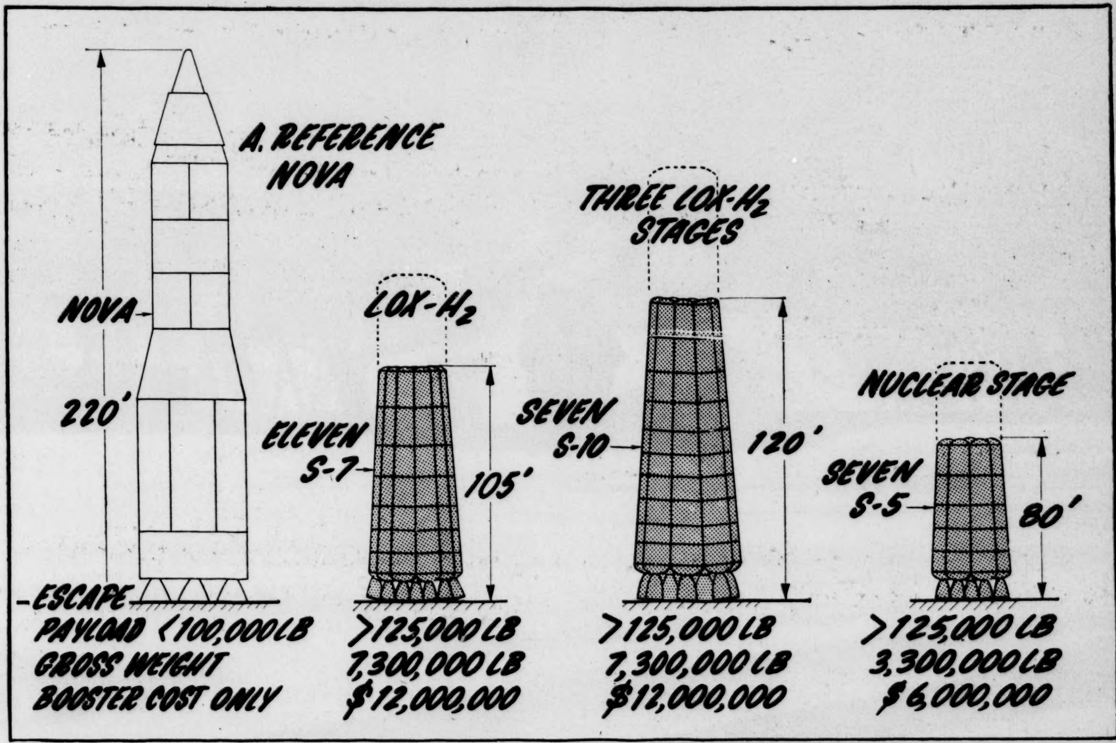
FAMILY of large conical solid rocket segments developed by United Technology Corp., showing flexibility of thrust level using same interior ballistic shape.


A. REFERENCE NOVA
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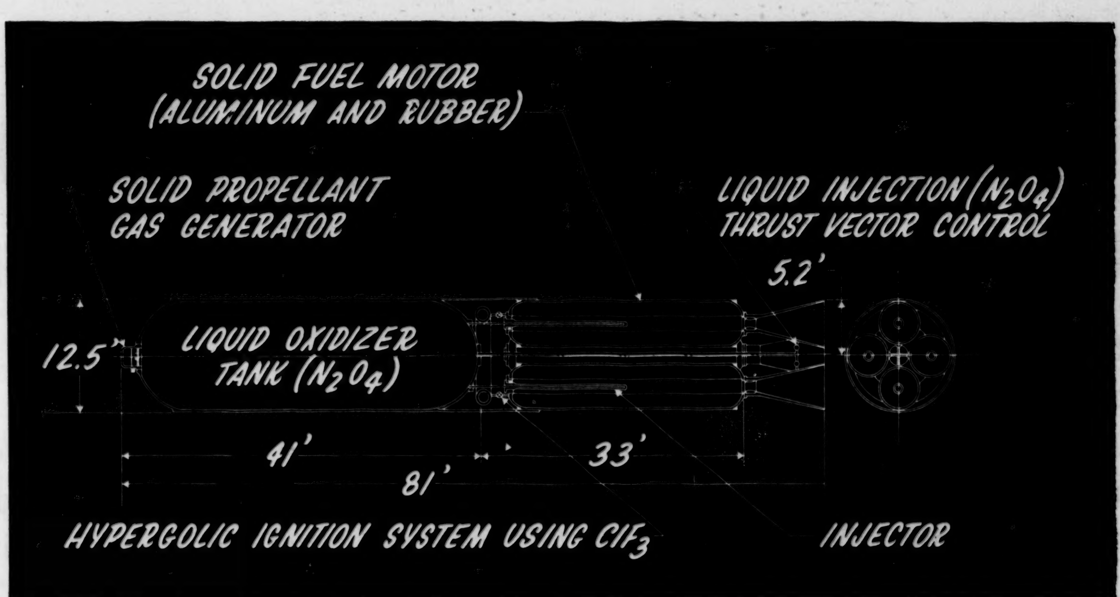
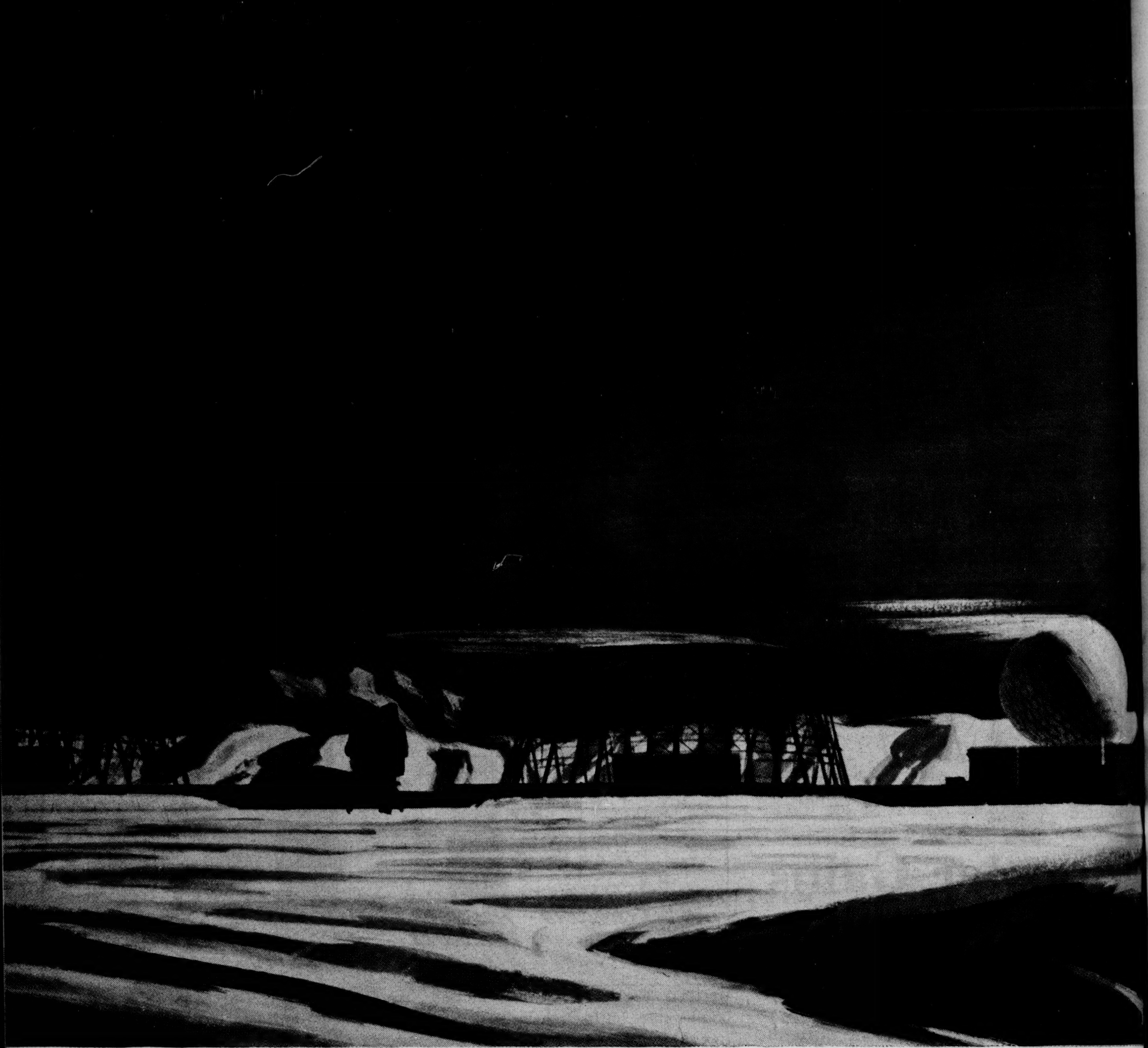
7,300,000 LB
$12,000,000
THREE LOX-H2 STAGES
SEVEN S-10
120'
>125,000 LB
7,300,000 LB
$12,000,000
NUCLEAR STAGE
SEVEN S-5
80'
>125,000 LB
3,300,000 LB
$6,000,000

UNITED TECHNOLOGY and Pratt & Whitney see clusters of segments forming the booster stage for large payloads, with the uprated liquid hydrogen-oxygen as upper stage in two configurations, and a nuclear second stage on a third vehicle.


SOLID FUEL MOTOR (ALUMINUM AND RUBBER)
SOLID PROPELLANT GAS GENERATOR
LIQUID INJECTION (N2O4) THRUST VECTOR CONTROL
5.2'
12.5'
LIQUID OXIDIZER TANK (N2O4)
41'
33'
81'
HYPERGOLIC IGNITION SYSTEM USING ClF3
INJECTOR

UNITED TECHNOLOGY Corp. 200,000-lb. thrust hybrid propulsion system is designed to combine the best features of liquid and solid fuel engines.

CREATIVE ELECTRONICS BY RCA



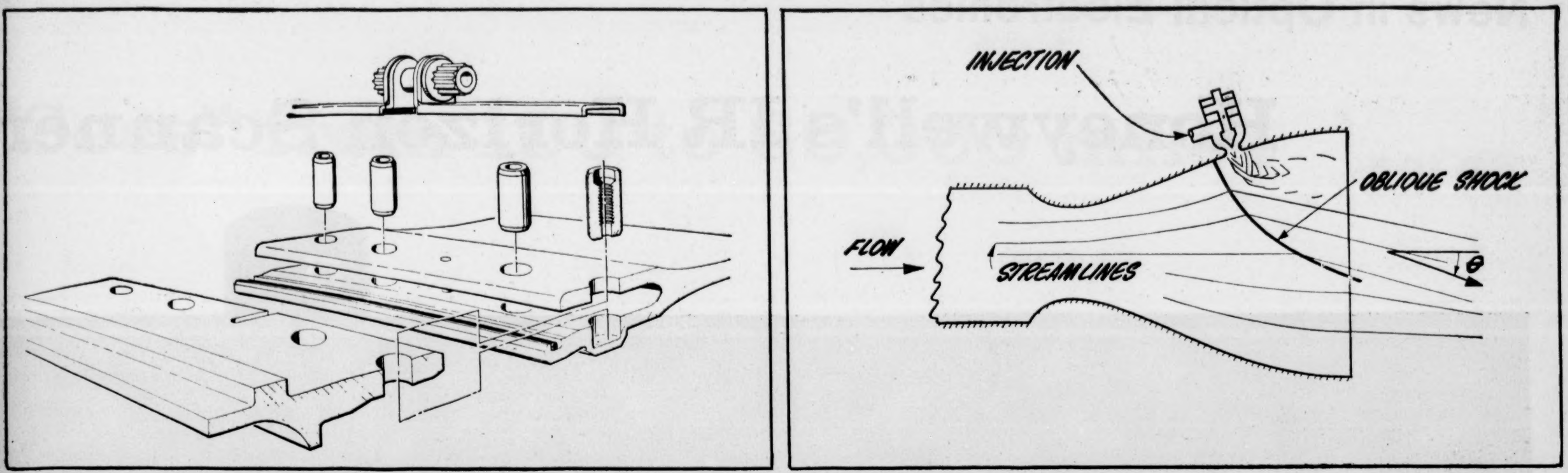
KEEPING BMEWS ON THE AIR

RCA Checkout and Automatic Monitoring Equipment Guards BMEWS Reliability Around the Clock

The incredible complexity of the BMEWS network and its vital mission in continental defense demand the ultimate in system reliability. Through unique and highly advanced developments by RCA this standard is being achieved.

The RCA Checkout Equipment installed at BMEWS sites performs a dual function—it generates and inserts realistic simulated target problems for on line exercising of the entire system. These integrated tests are designed to test the BMEWS early warning capability to its fullest extent. Automatic monitoring detects degradation prior to failure and isolates marginal conditions or malfunctions enabling rapid corrective maintenance.

Around-the-clock operation of this RCA equipment enables BMEWS to meet its over-all operability goal with negligible downtime, thus keeping BMEWS on the air!



LIGHTWEIGHT clevis joint has been developed by United Technology Corp. and Pratt & Whitney Aircraft to connect segments of solid rocket motors. At right, boundary layer shock is suggested by United Technology Corp. as a means of controlling thrust vector in large solid rockets. An oblique shock is induced in the nozzle by injecting a mixture of liquid nitrogen and oxygen.

Space Administration and the Atomic Energy Commission fully agree on the requirement to accelerate action on the nuclear rocket engine because of its great performance advantage over chemically-fueled systems. Industry feels the technological problems of the system can be solved to permit flight by 1965.

Because of funding limits, NASA has scheduled first test flight of the Nerva nuclear engine in 1966-67.

NASA estimates nuclear rocket development will cost $800 million to $1 billion, and the 1967 date could be optimistic unless the current funding pace is quickly accelerated. NASA-AEC Fiscal 1961 funding will total $47.6 million for the Rover nuclear space propulsion program.

Direct nuclear engine research is funded for $55 million in the Fiscal 1962 Eisenhower budget.

Solid Rockets Slighted

Although about $350 million of NASA's Fiscal 1962 money is earmarked directly for launch vehicle technology and development, proponents of solid rockets feel the possibilities of this type of propulsion are largely being overlooked. In the propulsion budget, $3.1 million is for solids. Air Force currently is doing considerably more work than NASA in large solids, including exploration of segmented solid rocket potential.

Much of the technology already exists for conventional propulsion advancement, industry feels, but some technical aspects of the nuclear engine remain unsolved.

Solution of these problems quickly and construction of a flyable engine are seen as the major hopes for catching and surpassing the Soviets.

F. T. Dixon, vice president of research and engineering for North American Aviation's Rocketdyne Division, characterized major problems as learning how to handle high reactor core temperatures; materials and health hazards associated with high intensity gamma and neutron radiation, and integration of the reactor into a flyable engine system.

L. E. Root, Lockheed Aircraft Corp. group vice president, told the committee that "we know of no technical problems which might cause a serious delay in the orderly development of a useful nuclear space-flight system." He said if a Saturn booster and second stage are available, and if the nuclear engine contractor is selected during 1961, the first test flight can be made during the latter half of 1965.

Nerva Engine Bids

Joint NASA-AEC office has requested bids, due Apr. 3, on the Nerva engine. The office told AVIATION WEEK it plans to award a contract to the winner by July 1. The winner is expected to be the single industry source for both non-nuclear and reactor components for the engine throughout the development program.

Both Root and James R. Dempsey, vice president of the Convair Division of General Dynamics Corp., urge concurrent, or parallel, feasibility study, design, research and development testing, manufacturing and operational use of the nuclear space vehicle.

Dempsey contends the first nuclear flight can be made "in less than 48 months from a decision to prosecute the program seriously" if the concurrent management concept is used.

The nuclear rocket, as third stage of a vehicle with clustered 1.5-million-lb. thrust Rocketdyne F-1 engines in its first stage and clustered 200,000-lb. Rocketdyne J-2 engines in its second stage, could place 190,000 lb. in a stationary orbit, 70,000 lb. on the moon and return, and 145,000 lb. in a Mars orbit, Dixon said.

Performance of Saturn with S-I booster powered by eight Rocketdyne H-1 engines, S-II second stage, with four J-2 engines, and nuclear third stage would be 81,000 lb. in a low earth orbit, and 35,000 lb. in an escape trajectory, Dempsey said.

Although test and first use of the nuclear rocket most likely will be as third stage of Saturn, Douglas Aircraft sees the nuclear space engine as the propulsion system for an economical space transportation system called Rita (for reusable interplanetary transport approach).

Douglas Rita Concept

Three-part Rita program, which could cost over $1 billion to complete, would have a flight test using a hydrogen-oxygen engine in 18 months and first nuclear-powered flight test in 1965, and would be performing lunar missions by 1966-67.

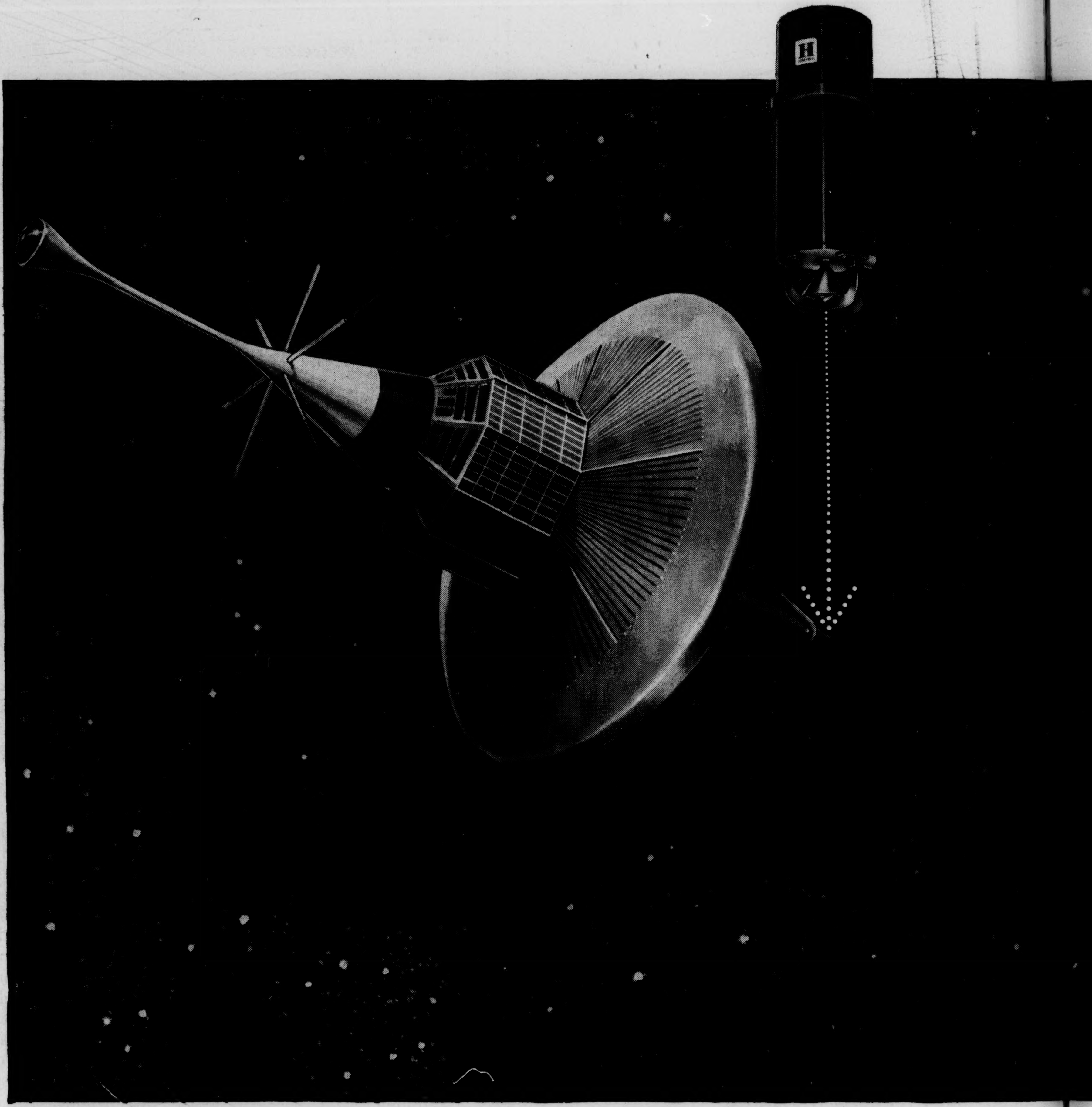
The program's operational schedule, however, would depend on the Rover-Nerva programs.

Development would consist of these vehicles.

- **Rita test vehicle,** using a Pratt & Whitney LR119 17,500-lb. thrust engine to flight test the semi-ballistic Rita configuration and systems, fly nuclear components, exercise the retrorocket system and check recovery techniques. Manufacture of 11 airframes could begin this year, and ballistic and orbital shots using an advanced Thor booster could begin in January, 1963. Precise recovery control, using Bell Telephone Laboratories radio guidance system, would be qualified during these flights. Booster, called Thorad, is a Thor with four assist rockets attached to the airframe.
- **Rita-A,** which would make use of the first nuclear engine available, with its size scaled to accommodate this engine. Present concept is a cone-shape, 40 ft. in diameter at the blunt end and 65 ft. high. Vehicle checkout would involve launch as a single stage in ballistic and vertical trajectories. As second stage on a Saturn S-I booster, it could orbit 85,000 lb. or land 10,000 lb. on the moon without refueling. Object of Rita-A is to conduct the earliest flight

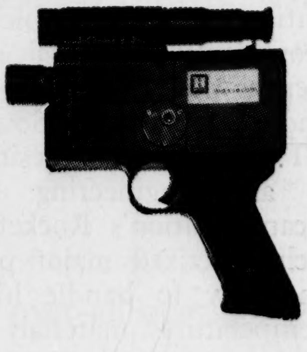
News in Optical-Electronics

Honeywell's IR Horizon Scanner



IR Detectors Typical Honeywell IR detector and preamplifier combination. This PEM (photo-electro-magnetic) cell operates at ambient conditions, non-cooled, and has a spectral response from 1-6 microns. Honeywell also produces cooled detectors for military and space applications.

Communications Honeywell's MAXSECOM* (Maximum Security Communications) transmits voice or coded intelligence via modulated infrared energy. Line-of-sight transmission gives security not obtainable in radio link. Solid state electronics and semiconductor modulator unique to MAXSECOM provide for compact, rugged, portable transceiver design. **Trademark*



"Sees" from 100 to 60,000 miles

Intensive research and development on the use of infrared for space exploration instruments gets special emphasis at Honeywell's Los Angeles Optical-Electronics facility.

Attitude sensing for satellites and planet exploration payloads to within 0.1° accuracy is possible with the unique design of the Honeywell LG61A Wide-Angle Horizon Scanner. Models of this infrared scanner meet a wide range of demands for attitude accuracy, life expectancy and range measurement. A scanner with no moving parts, using a semiconductor radiation chopper, is being designed for high reliability and long operational life. Further variation of the basic design provides for operation over the extreme altitude variations required in eccentric orbit missions.

Other infrared programs at Honeywell include the development and production of infrared detectors, surveillance and reconnaissance systems, communications systems, scanners and trackers, in-flight automatic refueling couplers and IR instrumentation devices and systems.

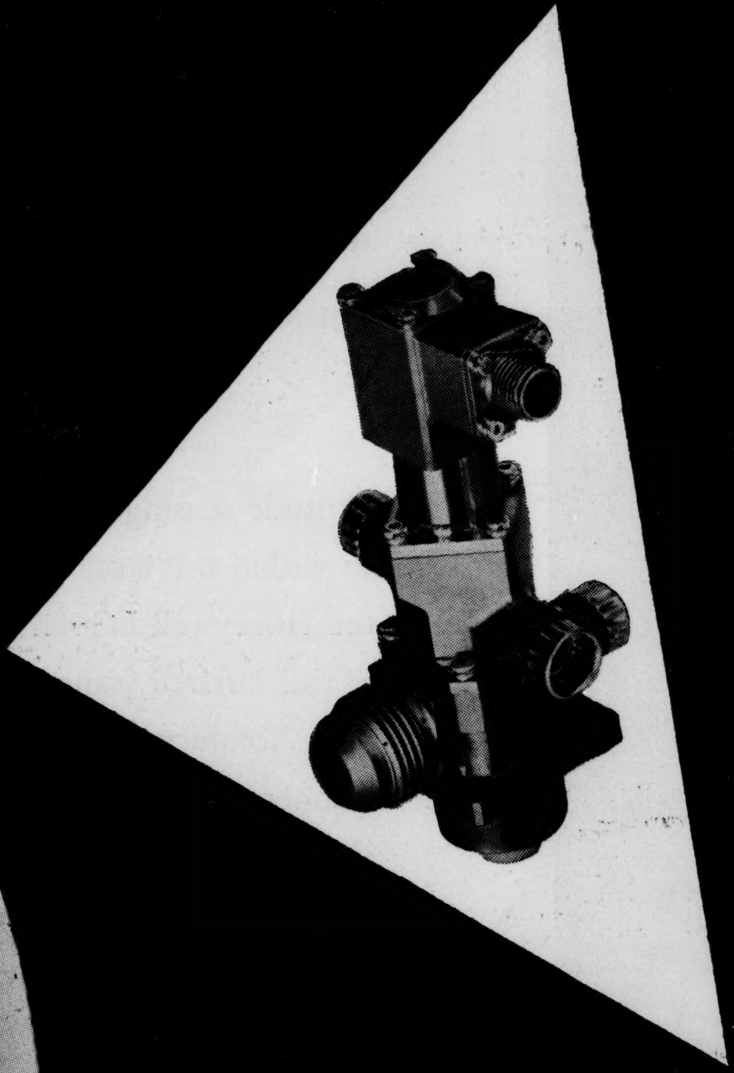
For further information on new developments in Optical-Electronics, call your nearest Honeywell representative, or write: Honeywell Aero Division, 1915 Armacost Ave., Los Angeles 25, California. *Sales and service offices in all principal cities of the world.*

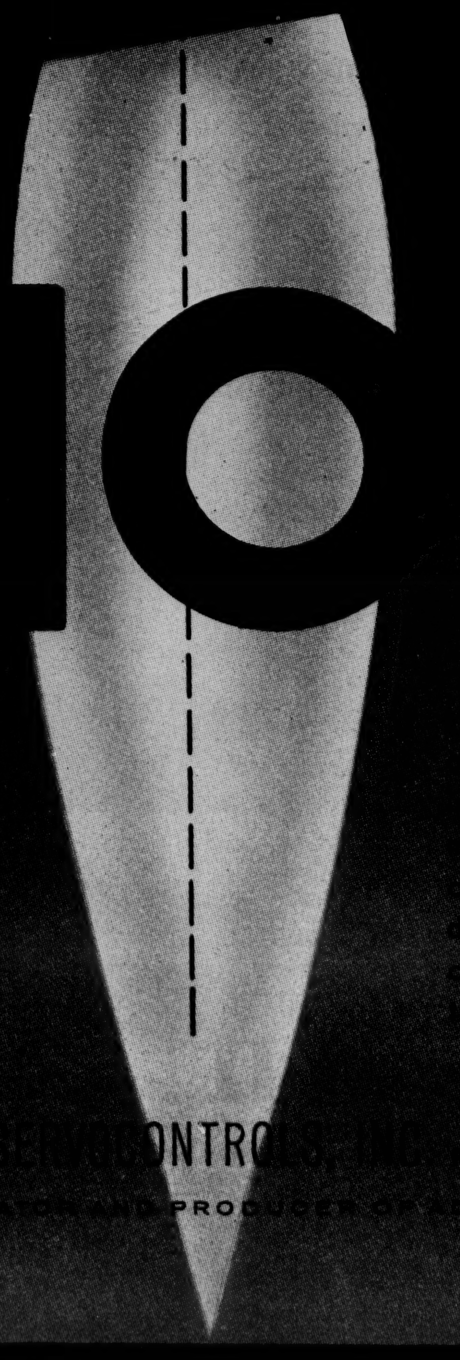
Radiometers
Honeywell has produced infrared radiation measuring instruments (typical shown) for a wide range of applications thru the spectral band from 0.7 to 40 microns.

Honeywell

Military Products Group

LIQUID SECONDARY INJECTION





characteristics. Actual [illegible] firings of Moog [illegible] have demonstrated the practicality of secondary injection thrust vector control. The experience gained in the design, manufacture, and test of these controls constitutes a unique competence.

MOOG SERVOCONTROLS, INC. PRONER AIRPORT, EAST AURORA, NEW YORK

LEADING INNOVATOR AND PRODUCER OF ADVANCED ELECTROHYDRAULIC SERVO COMPONENTS test of a nuclear vehicle as well as demonstrate its useful space mission capability. Douglas assumes the engine will produce 200,000-lb. thrust in a vacuum, with a specific impulse of 850 sec.

- **Rita-B,** the vehicle for interplanetary missions. Same configuration as the A version, it would be scaled up to 115 ft. high and 72 ft. in diameter at the blunt end. It assumes a vacuum thrust of 750,000 lb. and 950-sec. specific impulse. Although based on theoretical propulsion advances, Douglas feels the system is "within the capabilities envisioned for the 1967 time period." Payload performance would be 160,000 lb. in orbit; 25,000 lb. on the moon without refueling; 90,000 lb. on the moon with one refueling, and 45,000 lb. in interplanetary flight with multiple refueling. If the higher thrust-higher impulse engine is not available, Douglas proposes an alternative cluster of four 200,000-lb. thrust engines.

The Douglas configuration would have an optimum lift/drag ratio of 0.7 for a nominal re-entry deceleration of 2g at a 1.5 deg. re-entry angle. Because of its high base diameter, Douglas said Rita would experience re-entry heat loads of only about 2,000F. Ablating heat shield would be used, but it would not be affected in normal operation and the vehicle would not be refitted with a new shield except after emergency operation.

Safety Problem

Douglas, like most other companies, feels the nuclear rocket technical problems can be solved. The company considers operational safety the most difficult single hurdle to be overcome in nuclear propulsion. Because radioactivity is "held in awe and fear" by most people, the nuclear rocket program must include a method of convincing all who must be convinced of its acceptability.

General protections developed by the company indicate launch of a single-stage nuclear rocket from the ground would result in insignificant radiation dosages. In a malfunction completely vaporizing the reactor core, radioactivity would equal that of about a 0.1 kiloton nuclear bomb. If the explosion occurred in the early stages of flight, radioactivity would equal about a millionth of that from total nuclear bomb testing to date.

Added safety precautions would come in new methods of inerting reactor cores, and in selection of remote mid- or northern Pacific launch sites.

Alternate to Rita as test system for the first nuclear rocket is Apollo. Krafft A. Ehricke, director of the Centaur program for Convair, said unless an engine project is tied to a high priority mission, it is highly vulnerable to funding cuts. Because NASA's research funds were cut by $18.5 million last year, the F-1 engine program suffered because it was not firmly integrated into a mission project. He suggested a psychological advantage in defining the Apollo circumlunar mission as requiring the nuclear engine because the all-chemical Saturn is "uncomfortably marginal."

Apollo, like Project Mercury, probably will be given the top DX national priority, and Ehricke feels the Nerva engine should receive the same status.

Variety of Proposals

While agreement was general on the need to accelerate the nuclear engine timetable and differed only on the degrees of technical barriers, industry spokesmen were much more diverse in their proposals and philosophies to advance more conventional propulsion technology. The committee heard discussions of solids, liquids and hybrids, but the highly optimistic advantages cited for each system by its proponents were tempered by the divergent opinions expressed.

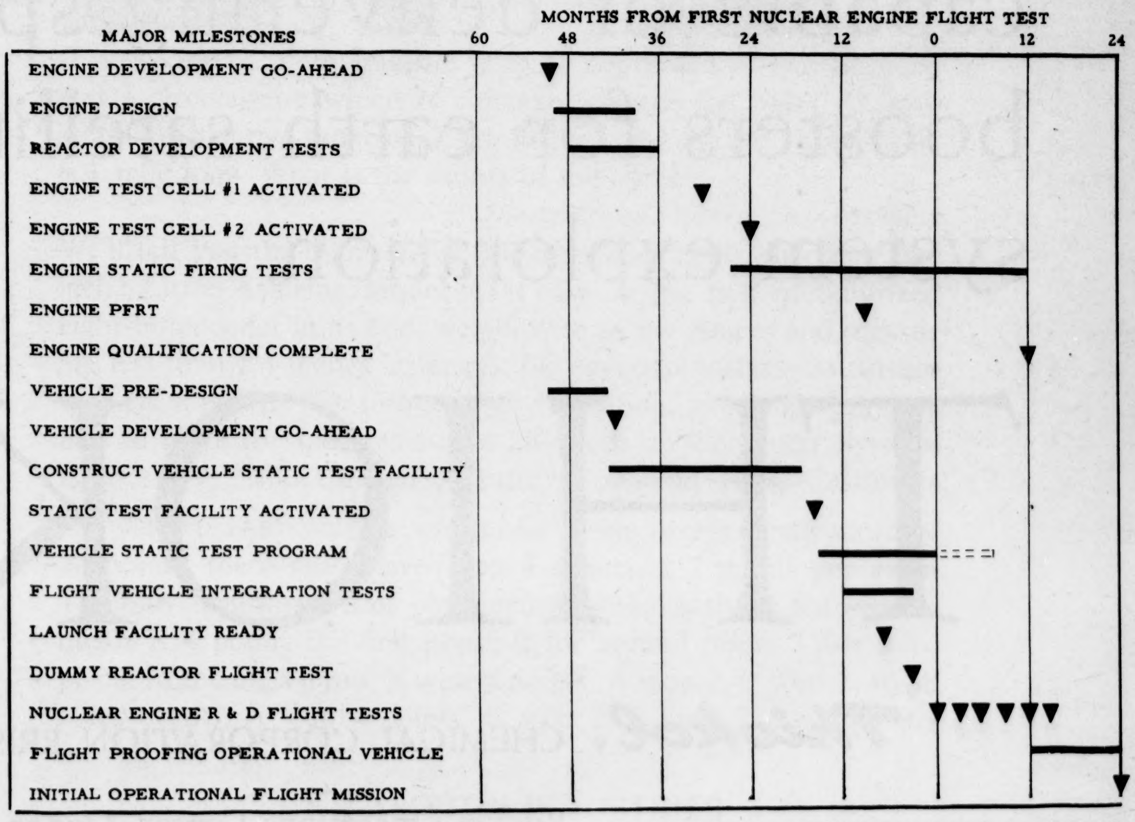
Martin Co. President William B. Bergen, who said the country seems "to have been on a theory binge" for the past three years, advised concentration on large liquids as boosters. "If there is enough time, energy and money left over, we should apply it to the solid booster," he said. He feels the cheapest way to develop "practical machines" is to practice, and large liquids are "more nearly reduced to practice than solids."

Bergen holds that there must be a clear distinction between NASA and defense booster goals because of the differences in arrangement, timing and emphasis. He sees the need for a single booster technology—in materials, processes and components—but a wide range of applications.

Pratt & Whitney Aircraft Assistant Chief Engineer Walter Doll said there is no one best method for accomplishing all proposed space missions—until all promising systems are developed, the merits of each can only be assumed.

United Technology Corp. and Pratt & Whitney Aircraft Division of United Aircraft Corp. propose immediate development of these systems in a comprehensive booster program:

- **High pressure hydrogen-oxygen** engine, with a vacuum specific impulse 10% greater than the 420 sec. for the Pratt & Whitney LR115, and "many times" its 15,000-lb. static thrust. As upper stage of a large segmented solid, it could help put 100,000-200,000 lb. on an escape trajectory in 5-6 years.
- **Recovery, for economy** of operation, using high speed aircraft state-of-the-art which now exists to design winged booster airframes. P&W says a recoverable winged booster, able to handle 35,000-lb. payloads, could be ready in 4-5 years.
- **Conical segmented solids,** a program now being conducted by United Technology with company funds. This fall, the firm plans to test fire a 500,000-lb. thrust segmented booster for 60 sec. United said flight weight engines could be built to deliver 2-million-lb. thrust by 1964 at a cost one-half to one-tenth that of the Saturn and Nova liquid systems. With immediate funding totaling $150-$200 million, a booster with 15-20 million-lb. thrust could be ready for flight in three years, the company said.
- **Hybrid propulsion** using a solid rub-



CONVAIR has developed this timetable for development of a nuclear rocket for space; it shows need for concurrent funding and work on several major milestones.

BIG BOOSTER

Thiokol is producing the largest single solid rocket motor to be flight tested, first stage of the Minuteman. Reliability has been demonstrated by a successful flight test and an 8-shot launch capability program. The same facilities, scientific and technical talents, and skilled management team responsible for developing this powerplant in record time are capable of delivering space-age size boosters for earth satellites and solar system exploration.

THIOKOL

Thiokol® CHEMICAL CORPORATION, BRISTOL, PENNSYLVANIA

Rocket Operations Center: Ogden, Utah

ber-based fuel and nitric acid oxidizer. The system is described as simple and low-cost, with potential as a large booster stage. Its full potential must await availability of the large solids. The basic problem is operating efficiency, but all other system elements are said to be straightforward applications of existing rocket technology.

United Technology segmented design is keyed to uniform segment parameters in propellants, web thickness and interior ballistic characteristics, which, it says, permits scaling-up size and thrust from one segment to 10 or more.

Individual segments, weighing 65,000-100,000 lb., could be connected by a UTC-developed clevis joint, and thrust vector control would be provided by injecting nitric acid in the nozzle to induce a boundary layer shock.

Segmented Rocket Cost

The company feels the delivered price of the large boosters could be $2 per lb. gross weight. It will static fire a 75,000-lb. motor in a single segment this summer. The motor will deliver 250,000 lb. thrust for 60 sec. The half-million pound thrust motor to be fired this fall consists of two segments with a total weight of 140,000 lb.

In its congressional presentation, United Technology said it does not recommend reduction of effort on the Saturn C-2 system, but its segmented system could be a "timely, completely usable, reliable backup at relatively low cost."

Replacing the S-1 cluster of Saturn H-1 booster engines in the C-2 with a cluster of seven two-segment motors could put 60,000 lb. in orbit at half the cost of the C-2, United Technology said.

Big push for application of solids as first-stage boosters also was made by Thiokol Chemical Corp. President Joseph W. Crosby, who emphasized simplicity, reliability, lowest cost and earliest availability for the space program.

Crosby told the committee Thiokol has the ability to develop a family of these four motors to satisfy all payload requirements through 1975:

- **Minuteman XM-55 clusters,** available immediately as a booster stage and able to orbit payloads up to 25,000 lb. with liquid upper stages. Cluster of seven XM-55s, each weighing 50,000 lb., presumably with three hydrogen-oxygen upper stages, could be used to orbit 25,000 lb. at a cost of $178 per lb. of payload. Same system could launch up to 7,000 lb. to escape velocity at a cost of $559 per lb. of payload.
- **TR-4 non-segmented motor** weighing 110,000 lb. which would be clustered as a booster stage, again using liquid engines as upper stages. Seven-motor booster cluster could orbit about 70,000 lb. at a cost of $159 per payload lb., or boost up to 22,000 lb. to escape velocity, at $495 per payload lb. First flight could be in 1965.
- **TX-555, a 67-ft. high,** 14-ft. diameter solid motor weighing 750,000 lb., which Thiokol says is based entirely on existing solid technology. Used as a booster in clusters of up to seven engines, with liquid upper stages, the company says it could orbit 320,000 lb. at a cost of $119 per payload lb., or accelerate up to 128,000 lb. to escape velocity at a cost of $447 per payload lb. First orbital flight could be in 1966.
- **TR-100, most advanced** in the Thiokol family. Weighing 4.5 million lb., it would be 108 ft. high and 24 ft. in diameter. Used singly with liquid upper stages, it could orbit 300,000 lb. or accelerate 100,000 lb. to escape. Orbit capability of 2.1 million lb. could be achieved with a cluster of seven TR-100s, and it could have escape capability of 600,000 lb., Thiokol said.

Site Change

Crosby suggests that the propulsion industry should move its manufacturing facilities to the launch site because segmenting for ease in transportation becomes impractical when the boosters weigh millions of pounds. If launch site

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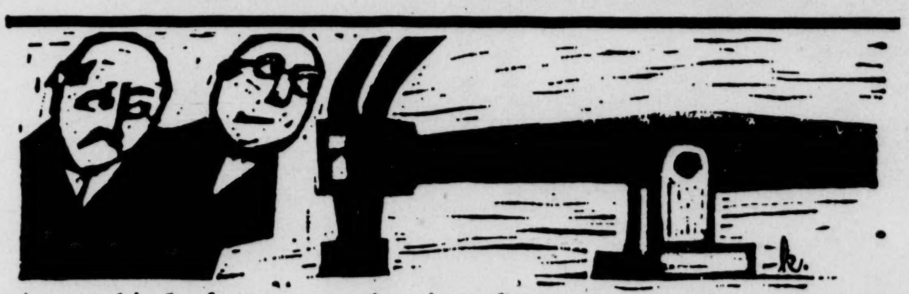

PROBLEMATICAL RECREATIONS 58

A new kind of atom smasher is to be composed of two tangents and a circular arc which is concave towards the point of intersection of the two tangents. Each tangent and the arc of the circle is 1 mile long. What is the radius of the circle?

—American Mathematical Monthly

We'll tell you the diameter of our new shaft angle encoder: one inch! Litton Systems Model AD11-08s is the first miniaturized eight-bit encoder in its line, weighing in at 1.8 ounces and measuring less than 1.4 inches in length. No space to amaze you further with facts like its low torque, high resolution, and long operating life, so write for specs and read all about it: Computer Systems Laboratory, 5500 Canoga Avenue, Woodland Hills, California.

ANSWER TO LAST WEEK'S PROBLEM: With an aggregate score of 28 points, there must have been 4 events at 7 points per event. The only combination of place scores which satisfies the requirements is 4 points for first place, 2 for second place, 1 for third place. In the high jump, B won 4 points, A won 2, C won 1. In all other events, A won 4 points, C won 2, B won 1, consequently A won the pole vault.

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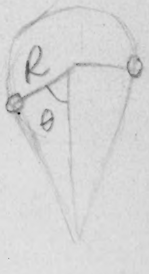
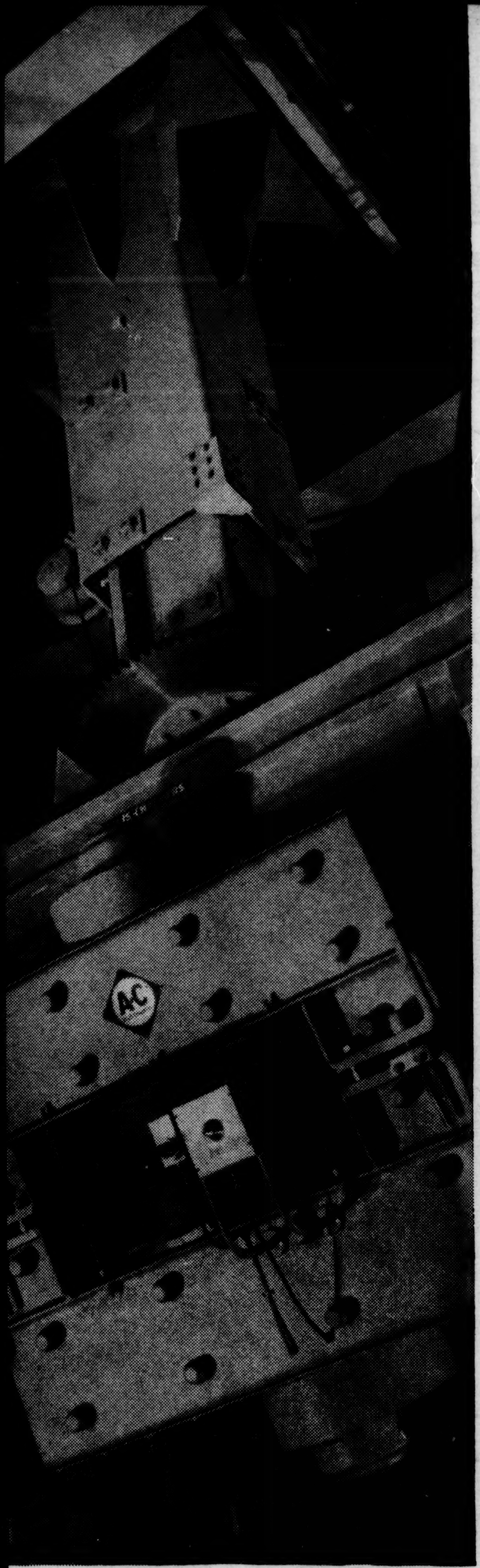


SPACE . . . IMAGINATION . . . ENERGY



Here twenty-five million electron volts probe the inmost secrets of a missile

Vastly more powerful than any known industrial X-ray apparatus, the Betatron yields a clear picture through the full girth of the third-stage Minuteman engine in an eight-minute exposure, contrasted with more than a nine-hour exposure required with 1,000 curies of cobalt 60. Resolution is such that irregularities down to 0.01 inch can be examined. Power of the instrument, and dimensioning of the building which houses it, are more than equal to the task of scrutinizing interior topography of the cast composite double-base solid-propellant motors made at Bacchus: the third-stage Minuteman, advanced second-stage Polaris, Altair, and the others.

Within these labyrinthed entrances, shielded from the world by six feet of reinforced concrete and full-height earth barricades, lurks the mighty Betatron. Its task: to search out any defect in production-line propellant grains exposed to its powerful X-ray eye.

This giant eye is only one part of our complete nondestructive test installation at Bacchus. Through such steps, the life history of each individual unit becomes an open book—its reliability can be computed, its readiness known before the need arises. Such exacting tests pave the way to space.

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B-52 and other military aircraft will be protected by the most potent Electronic Countermeasures equipments yet devised. These equipments were developed in close teamwork with the Air Force under Hallicrafters' QRC (Quick Reaction Capability) program. Now qualified to meet full environmental specifications, they are in quantity production.

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World Wide "Blue Streak" Project

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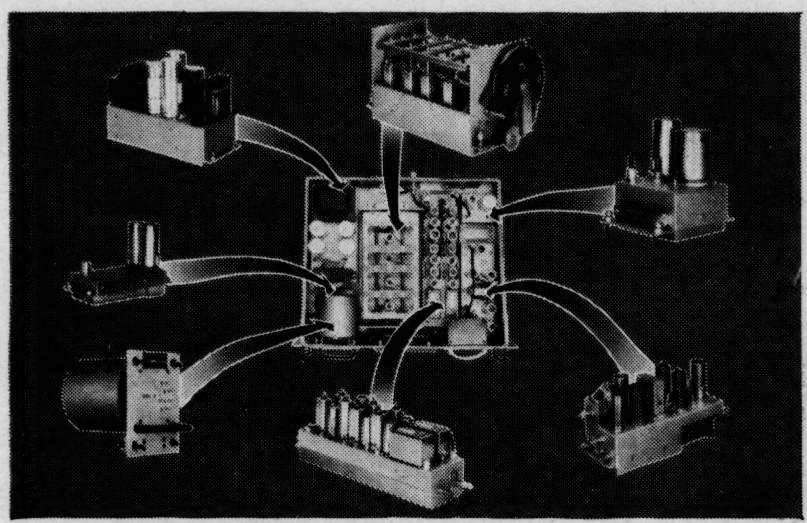
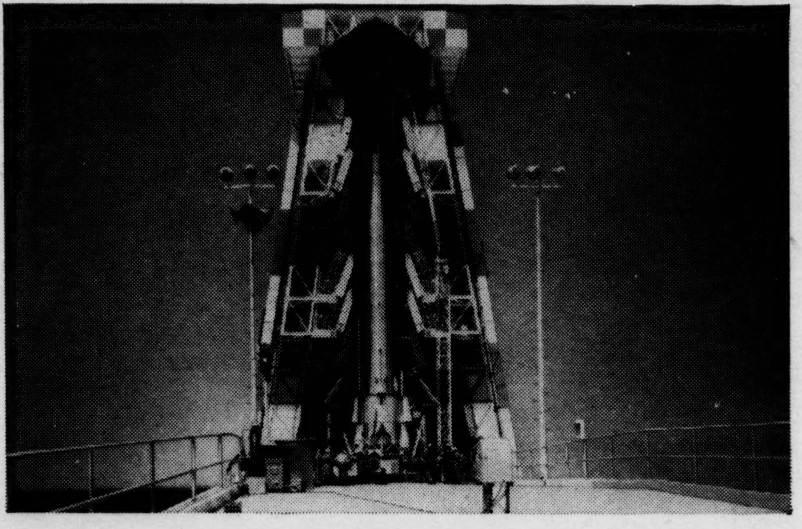
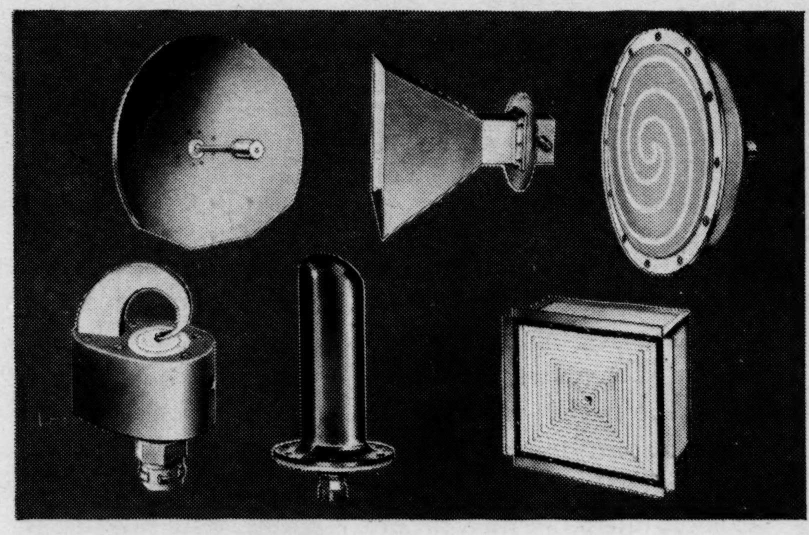


Hallicrafters communications leadership is exemplified by new high frequency Single Sideband receiver, (model no. SX-116). 100% modular design permits simple modification for compatability with existing and future communications systems. Stability, with proper available plug-ins, is better than one part in 10,000,000 per month. Hallicrafters also offers an existing capability in receiving and transmitting techniques up to frequencies of 50,000 megacycles.



Hallicrafters participation in the Atlas missile project helped to develop capability for many areas of the complex missile field, including code translator data systems; ground support equipment; ECM testing and antenna systems. Current explorations involve latest Infra Red techniques.



Airborne antennas and micro-wave components with power capability in excess of 1,000 watts, can be made available to solve tomorrow's very high power handling requirements. Testing of microwave components is possible with special high power generators, designed and built by Hallicrafters.

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For further information on Hallicrafters facilities and experience in military electronics research, development and production, please write to:

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Military Electronics Division,
Chicago 24, Illinois

real estate is scarce or expensive, solids can be built in dry basins and floated to the site, he said. An aggressive space program based on solids could bring gross vehicle weight cost to about $1 per pound, Crosby claimed.

Proper Application

Rocketdyne President S. K. Hoffman feels low cost "is not an exclusive virtue of any one type" of propulsion system, but will apply to the engine best used. In an analysis of merits of each system, he said solids are best used in tactical and strategic applications and for armaments and JATO, but liquid and nuclear propulsion must be used for more ambitious missions.

Hoffman sees recovery of liquid boosters developed to the point where they can be used 50-100 times, which would reduce the cost of launching space missions essentially to the cost of the propellant.

Broader effort in all areas of propulsion was urged by Aerojet-General Corp. President Dan A. Kimball, who said inadequate support of advanced components and concepts "has been a continued weakness in our ability to advance rocket technology."

Kimball labeled the present space program "meager" because of insufficient booster capability and suggested acceleration of these projects to augment it:

- **Segmented rockets:** Aerojet is now conducting a USAF program which could lead to a segmented solid in 2-3 years, able to deliver 2.5-3 million lb. thrust for 60 sec. Main problem is large nozzle development.
- **Pressure-fed engines:** Although heavier and not competitive with pump-fed engines in ballistic missiles, they are simpler to build, cheaper, highly reliable, and have high performance characteristics in space applications. Theoretical pressure-fed engine could deliver 15-20 million lb. thrust, put 250,000 lb. in orbit, and be completely recoverable.
- **Booster recovery:** development of runway landings or flyback systems based on inflatable structures or Rogallo wings could reduce the cost of an orbiting payload from the present $1,000 per lb. to $5-$30 per lb.

NASA propulsion officials assured the committee that the agency is not biased against solid propulsion, but Rep. Victor L. Anfuso (D.-N. Y.) asked that an impartial study be made for the committee by NASA on solids and liquids. Maj. Gen. Don R. Ostrander, NASA launch vehicles director, who agreed to the study, said he has recommended that the agency increase its request for solids from $3 million to $18 million, and increased liquid rocket funding from $68 million to $83 million in the Fiscal 1962 budget.

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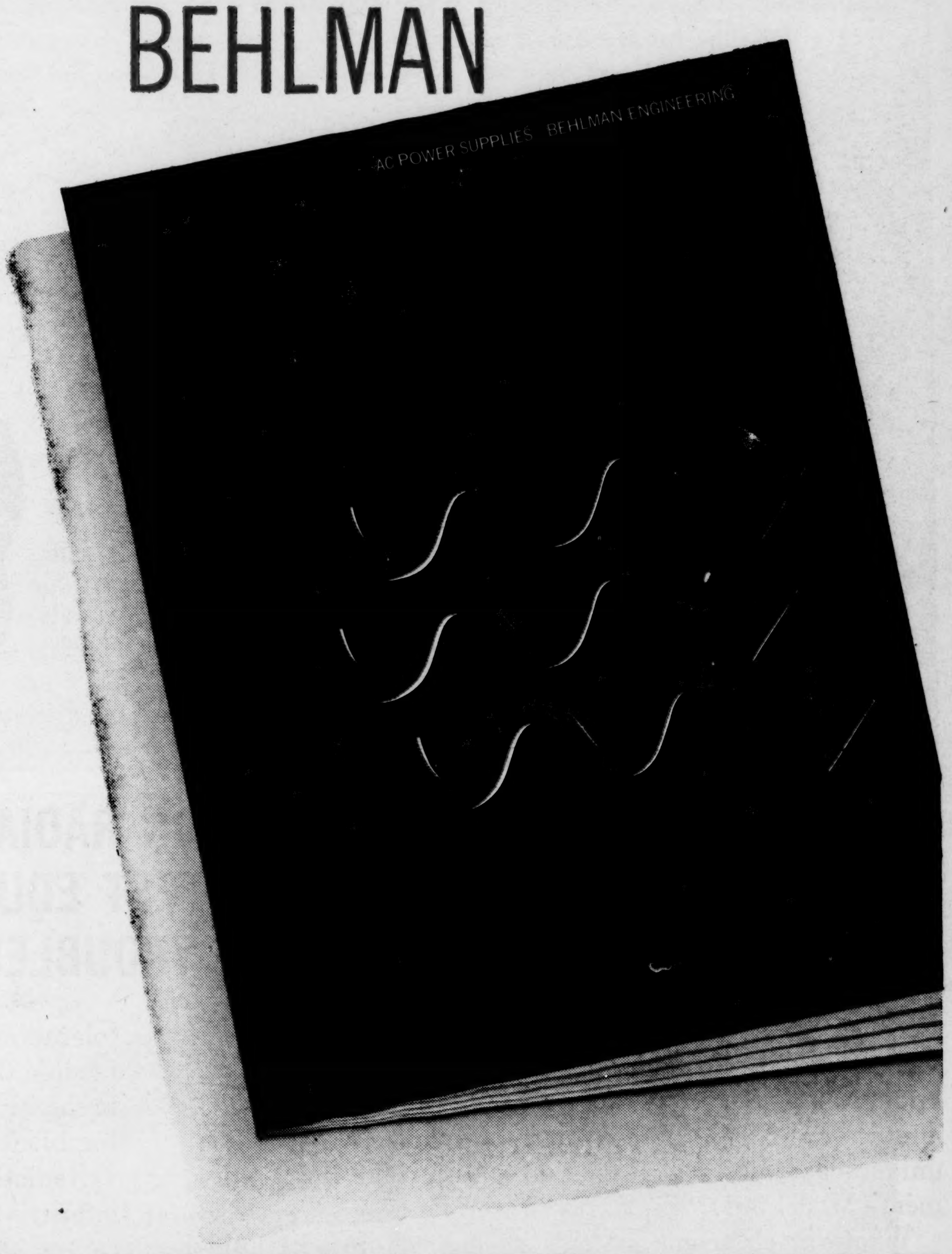

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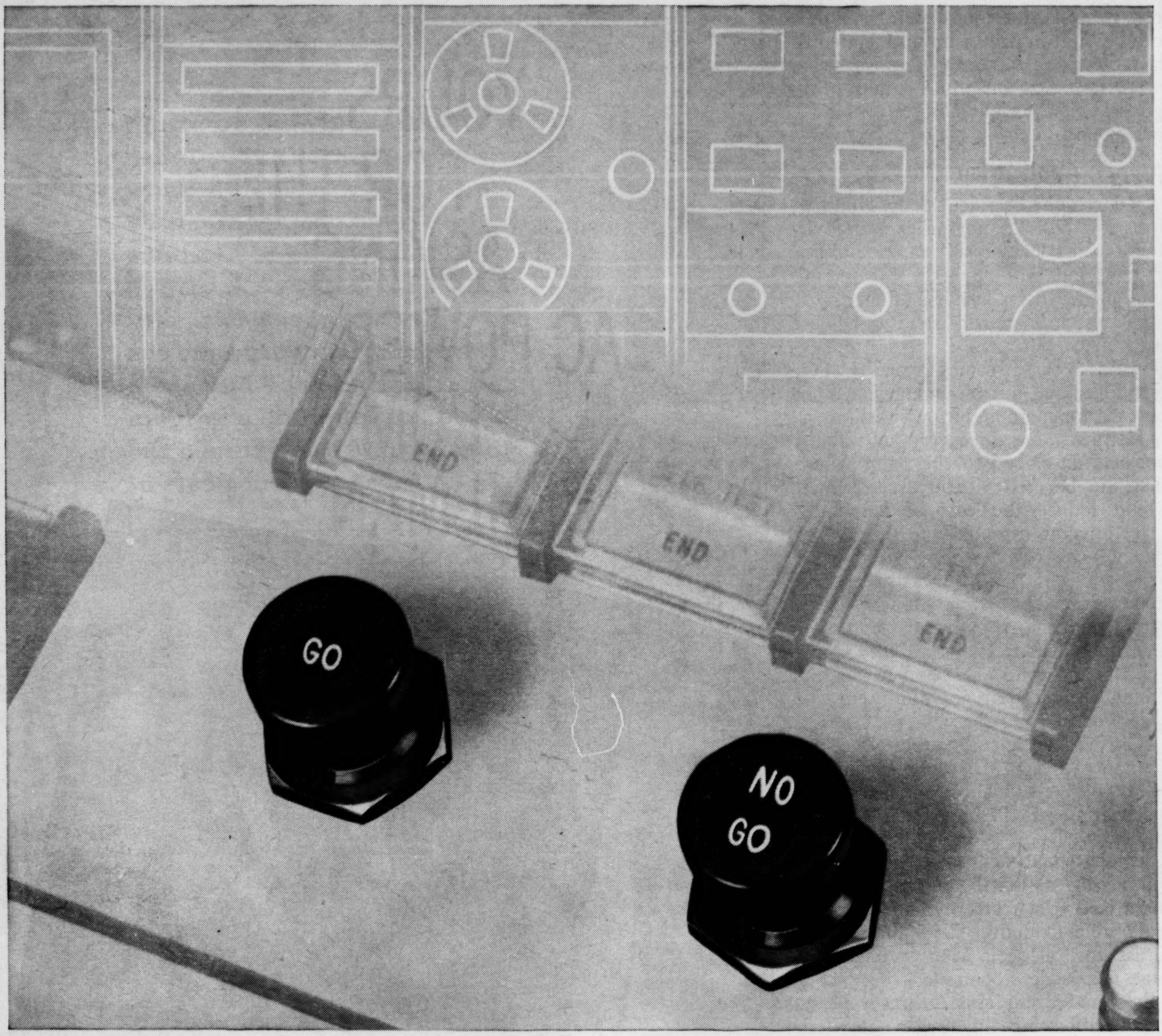

THEY RELY ON RADIATION'S AUTOMATIC TEST EQUIPMENT TO PIN-POINT "LITTLE" TROUBLES IN BIG SYSTEMS

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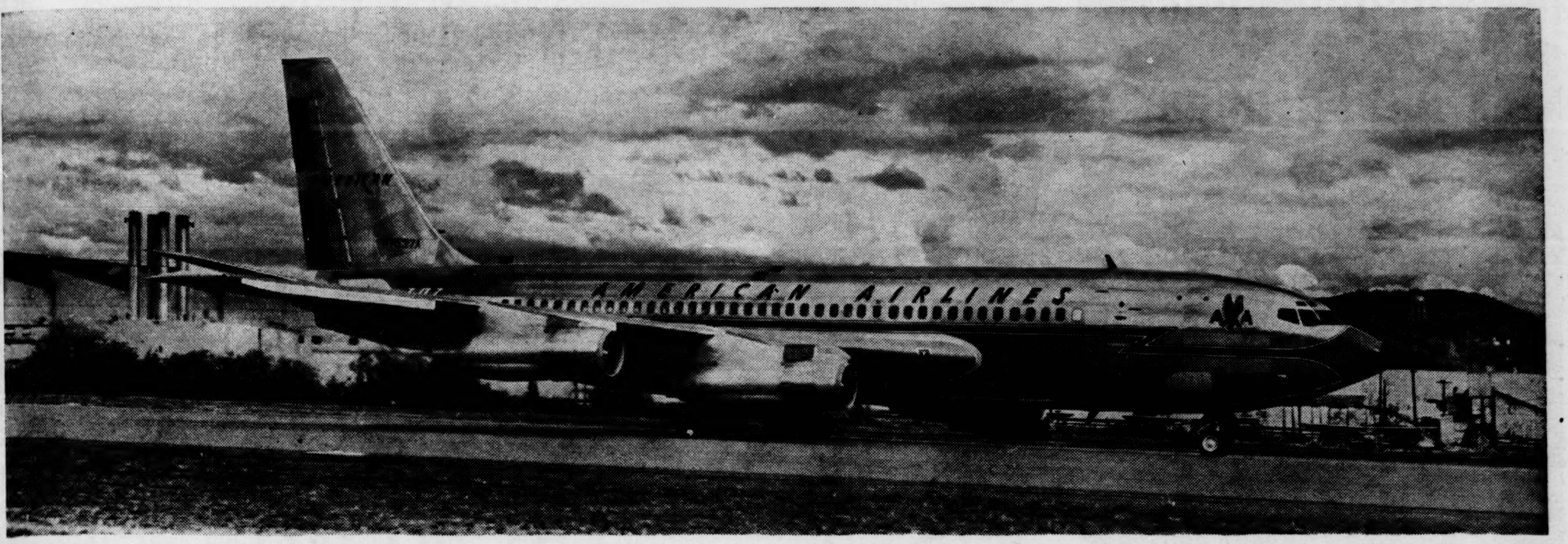


PERFORMANCE of the Boeing 720B is increased over its predecessor 720 because of a 40% increase in available thrust with only a 15% increase in allowable gross weight. First 720B off the production line for American Airlines is shown just prior to a takeoff.

Aviation Week Pilot Report:

Turbofans Reduce 720B's Takeoff Roll

By William S. Reed

Seattle, Wash.—Better takeoff performance, lower fuel consumption and higher payload-carrying capability are the most notable features of the Boeing 720B which enters American Airlines service this month.

Thrust increase of 40% supplied by the four turbofan engines enable the 720B to cruise at 630 mph. at 25,000 ft., take off from one-third less runway than the 720 at comparable weight, use 20% less fuel at comparable speeds and operate at a gross weight 20,000 lb. in excess of its predecessor 720.

Improved performance, most notable of which is a short takeoff run and rapid climb, was demonstrated during a recent AVIATION WEEK pilot flight in a 720B at Boeing Field. Ability to operate from high altitude airports will permit American Airlines to offer service into Mexico City's 7,340-ft.-high airport (AW Feb. 27, p. 39).

The flight included a summary of the maneuvers illustrating handling qualities in Boeing's customer training program, given by Paul Maier, experimental test pilot and customer checkout instructor.

Only external differences apparent between the 720B and the 720 are in the larger engine nacelles and in an increased horizontal stabilizer area.

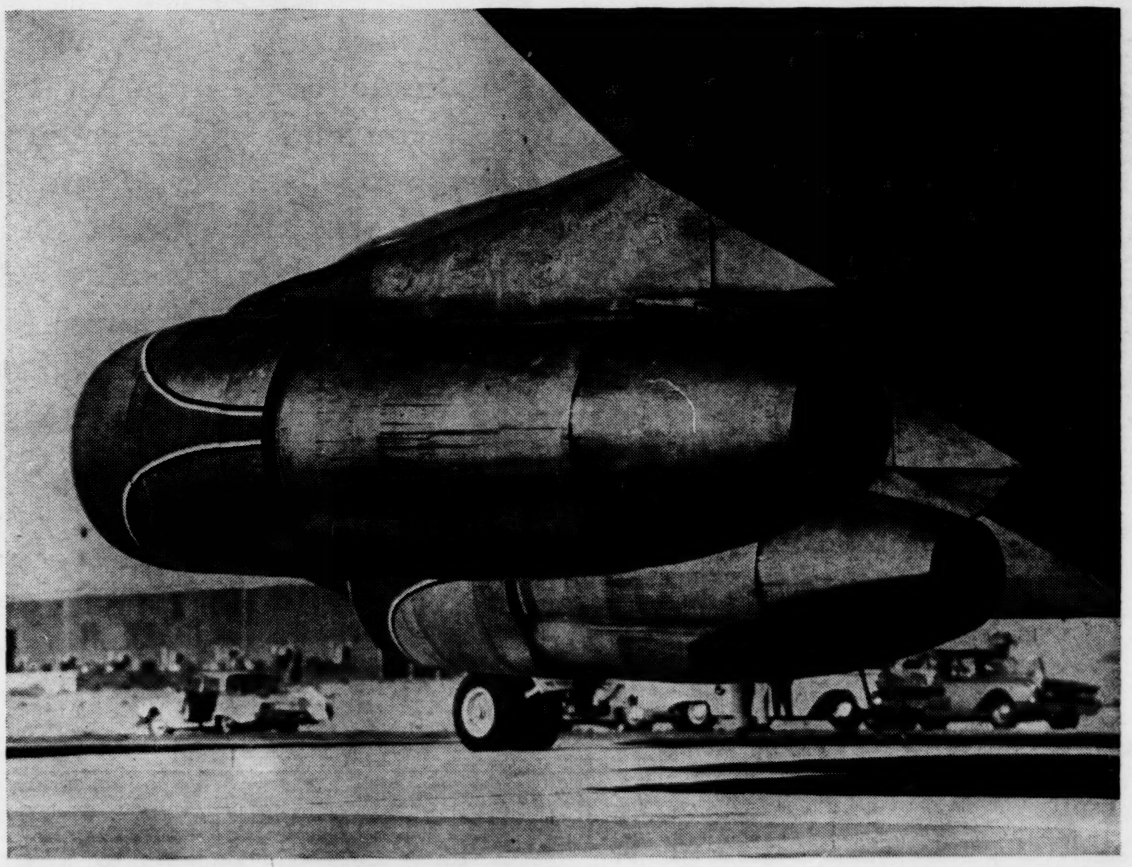
Aircraft flown on this flight was N7541A, the fifth 720B off the line for American Airlines. With 12 persons and 56,000 lb. of fuel on board, the aircraft gross weight was 166,298 lb. Maximum allowable taxi weight of the 720B is 235,000 lb.; maximum flight weight is 233,000 lb.

Weather prevailing at Seattle's Boeing Field on the day of the flight was: temperature 6C (44F); wind from the east at 15 kt.; altimeter 30.18; sky conditions 5/10 with intermittent drizzle.

Pre-Takeoff Calculations

Pre-takeoff calculations showed that aircraft loading conditions with the center of gravity at 24 mean aerodynamic chord called for the following settings: elevator tim, 2 deg. nose up; engine pressure ratio (EPR)—the ratio of total turbine exhaust pressure to total engine inlet pressure—1.76; N_1 rpm. (forward compressor) 103.6%; V_1 speed, 103 kt.; V_r speed 113 kt.; V_2 speed 130 kt. The aircraft, with Clayton Scott, Boeing's chief production test pilot, in the left seat and Maier in the right, was taxied to position on Runway 12. Maier did the taxiing from the right seat demonstrating that nose wheel steering is not needed for control on the ground because of the castering action of the nose wheel.

Performance of the 720B, in com-



MAXIMUM ENVELOPE diameter of 17,000-lb.-thrust Pratt & Whitney JT3D-1 turbofan engine is 14 in. greater than that of the JT3C-7 turbojet which powers the 720. Bypass air acts as an aerodynamic cushion for the exhaust, obviating the need for sound suppressors.

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parison with the straight 720, especially at so light a gross weight, is impressive. The 720, with Pratt & Whitney JT3C-7 engines developing 12,000 lb. thrust, is a good performing aircraft (AW Aug. 15, 1960, p. 56) but the B model has over 40% more power. Its P&W JT3D-1 engines each develop 17,000 lb. thrust, permitting very rapid acceleration on takeoff and very steep second segment climb. Floor angle, in fact, probably exceeds that which the airlines will care to use and power either will be reduced or airspeed will be faster than the certificated values specified for regular operation.

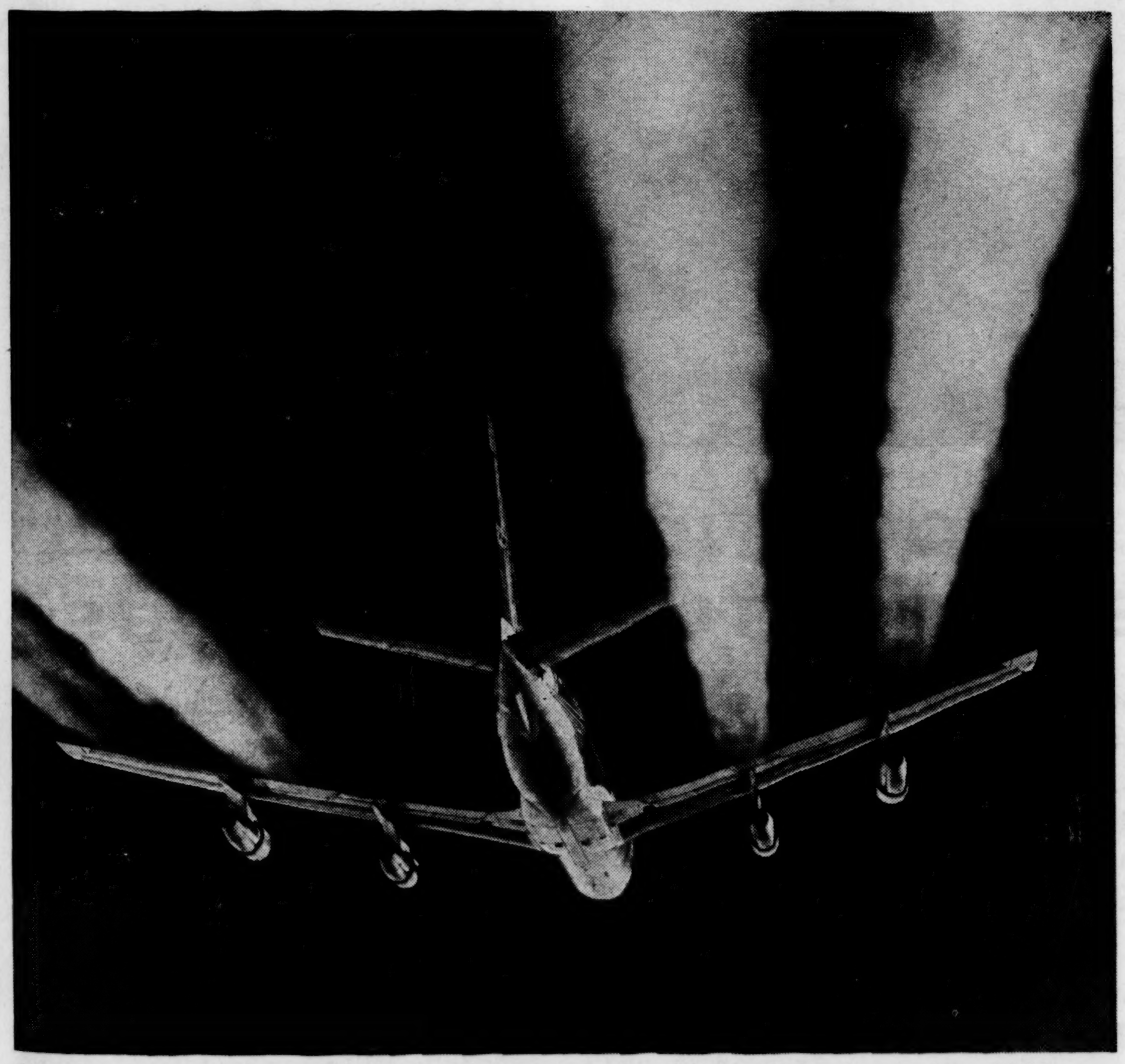
No effort was made to make this a maximum performance climb and the aircraft rose at an indicated airspeed of 310 kt.—best climb speed for maximum range. Had the immediate gain of altitude been the objective, climb speed would have been held at 260 kt. and the recorded performance been more impressive. However, 4½ min. after takeoff, the aircraft passed through 10,000 ft., indicating a 4,800 fpm. rate of climb. The 720B passed through 15,000 ft. one minute later, through 20,000 ft. 7½ min. after takeoff and reached 30,000 ft. exactly 10 min. from start of takeoff roll. Climb power used was N_1 of 102% with EPR of 1.7. Full gross weight rate of climb is estimated at 3,500 fpm.

Maier and Scott leveled the aircraft off at 30,000 ft. to conduct systems checks, mainly the trim of the aircraft and the functioning of engine surge bleed valves.

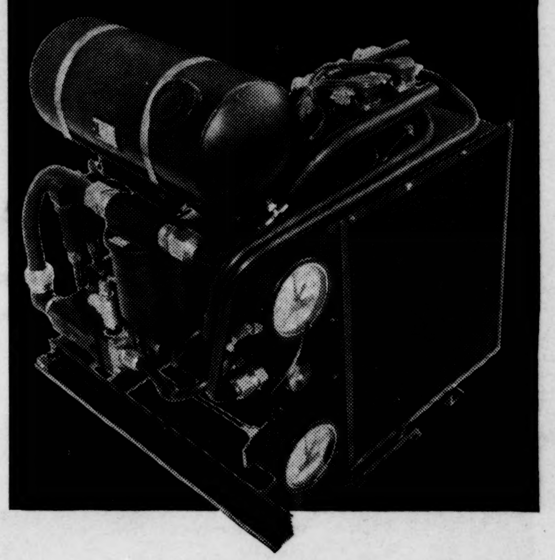
The aircraft settled down to a cruise speed of Mach .88 (roughly 597 mph.) at 30,000 ft. with the following indications: EPR 1.63; N_1 97%; indicated fuel flow 3,500 lb/hr./engine. Indicated airspeed was 330 kt. and indicated true airspeed was 509 kt. Scott then relinquished his seat to this pilot and Maier commenced his demonstration of the aircraft's shortcomings and capabilities.

Time did not permit a complete rundown of Maier's routine but included the more important aspects of the flying qualities typical of large, high-performance, swept-wing aircraft. As a prelude to checking out new pilots, Maier demonstrates all the unusual handling qualities and emergencies, together with the proper procedures and techniques. Students are assured of their ability to cope with the machine and continue the transition course with greater confidence and better understanding, Maier says.

First item was a demonstration of the cruise capability of the aircraft. Power was boosted slightly and the aircraft accelerated quickly to the point where the Mach limit warning bell sounded, approximately .91 on the Machmeter, actually .906. Shortly be-



CONTRAILS formed at 37,000 ft. during Aviation Week flight in Boeing 720B over Washington state. Note exhaust ducts for bypass air from forward fans, and increased area of horizontal stabilizer to compensate for destabilizing influence of 40% power increase.



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AiResearch electronic cooling units for U.S. Army Hawk missile mobile ground radar equipment require only half the space originally allotted. These lightweight production units, with a heat rejection capacity of 10 KW, measure 20" x 24" x 24".

A complete system package, the liquid-to-air unit includes an accumulator, pump, heat exchanger, fan, switches and valves.

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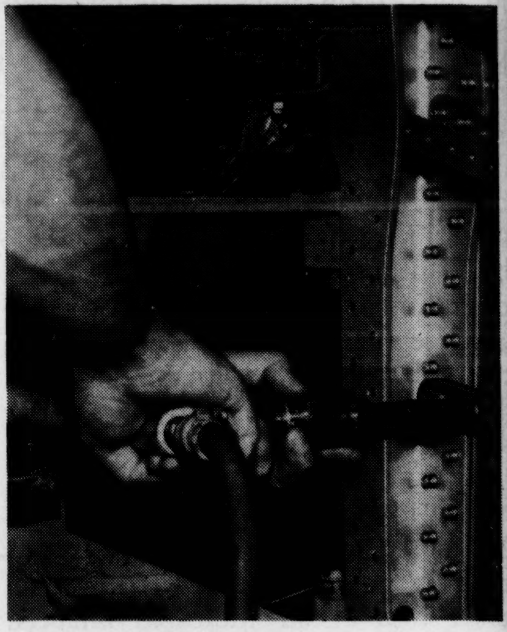
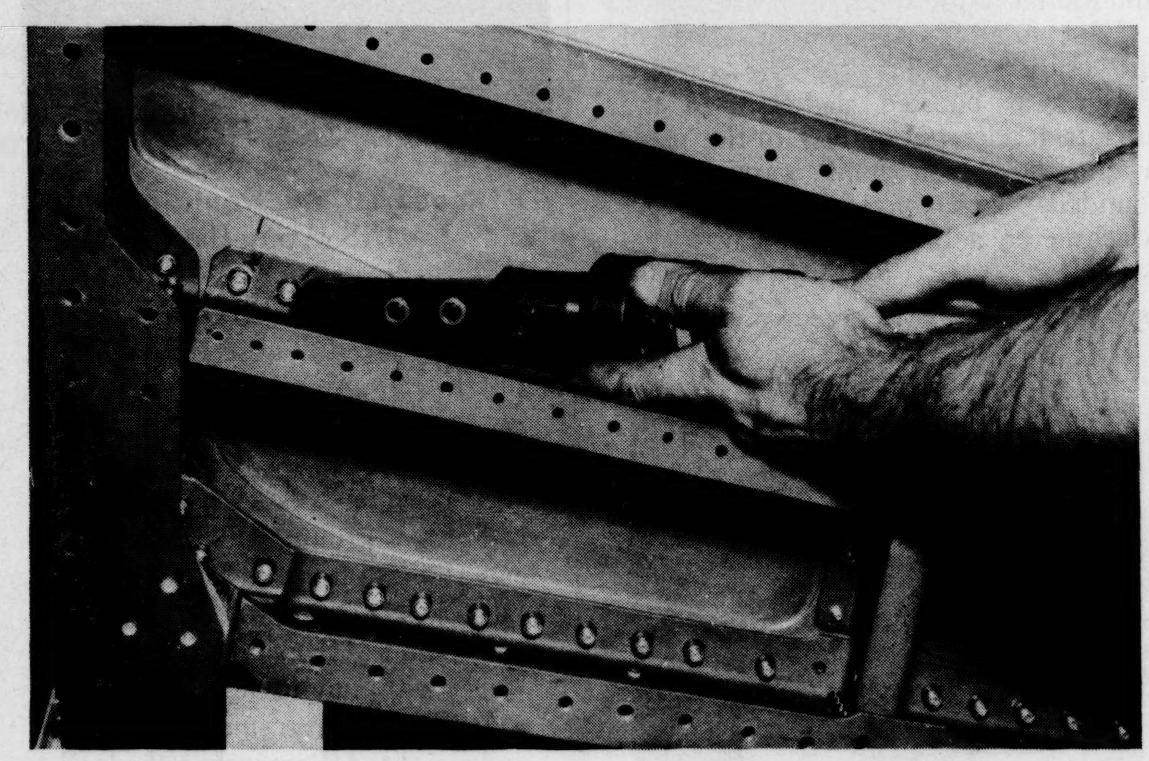


Hi-Lok 2″ offset extended adaptor fitted to an Ingersoll-Rand Air Motor reduces a 2-man, 32-hour assembly job on the landing gear steel support rib to a one-man, 4-hour job. Additionally, the change to Hi-Loks reduced the installed fastener rejection rate from 30% to practically nil.

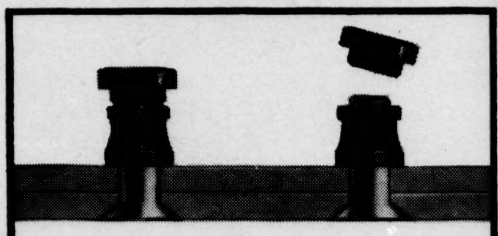
Upper photo: Hi-Loks fasten the entire lower skin panel to ribs and beams.

Lower photo: Modified 20° attachment tool on Keller Air Driver installs Hi-Loks on beam flanges. The Hi-Lok installation is quiet and eliminates the progressive pounding to the structure normally associated with the installation of swage type fasteners using pneumatic hammers.



hi-Lok*

FASTENER CUTS 32 HOUR JOB TO 4



CONTROLLED PRELOAD...the torque-off feature of the Hi-Lok collar *automatically* gives a preload condition *consistent within* ±10%. Because of the torque-off feature, torque wrench inspection after installation is not required.

HI-LOK OFFSET TOOLING CIRCUMVENTS STRUCTURAL FLANGES

The change to high strength Hi-Lok Fasteners and Hi-Lok tooling on the Northrop T-38 Talon supersonic jet trainer, overcame acute accessibility problems caused by wide flanges on structural ribs and beams in the thin, single panel wing. The switch to Hi-Loks from swage type fasteners resulted in a substantial savings in installation manhours.

More than a 50% tool cost savings alone was realized at Northrop when swage fastener tooling, with its single purpose power units, squeezer yokes and other special tooling was replaced with simple Hi-Lok offset tooling adapted to standard, multi-purpose air driver motors.

Installation rates up to 45 Hi-Loks per minute are obtainable using automatic drivers where the structure is open and when speed of installation is essential.

Contact your Engineering Standards Group or write directly to us for additional data on Hi-Loks and our other fastener products.

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2600 WEST 247TH STREET, TORRANCE, CALIFORNIA, U.S.A.

CHECK of 720B's high-altitude performance is made at 36,500 ft. Aviation Week pilot William S. Reed is at the controls; Boeing pilot Mike Gladych is behind him.

fore, Mach effects were felt on the airframe and the automatic trim system started to compensate for the nose-down pitching moment caused by rearward travel of the center of pressure. Power was reduced simultaneously with the sound of the warning bell but it was evident that the aircraft can cruise at its limiting Mach number without boosting power above maximum cruise limits. Cruise speed at the limiting Mach number of .906 works out to about 615 mph. at 30,000 ft. and to about 627 mph. at 25,000 ft.

Systems Checks

The aircraft then was taken to 40,000 ft., where further systems checks were made. At this altitude Maier set up conditions that produced Dutch roll, which consists of roll and yaw oscillations uncomplementary to each other. It is common with swept-wing aircraft. Normal technique of trying to damp the lateral oscillations by the use of aileron control only aggravated the situation because of the inertia of the aircraft about the longitudinal axis and the inertia inherent in the mass of the engines on the wings.

Using aileron only caused the maneuver to become more rapidly divergent. Proper corrective action was initiated by Maier in the form of rudder opposite to the direction of yaw, an unnatural maneuver to a pilot accustomed to high-performance military jet fighter-type aircraft.

The maneuver was repeated twice more to demonstrate the effectiveness of the recovery together with actuation of the yaw damper, which is the most effective means of preventing Dutch roll and of stopping it once it has gotten started.

Dutch roll is a characteristic of all large swept-wing craft and most smaller ones as well.

In the 720B, Dutch roll was induced deliberately by de-activation of the yaw damper and by asymmetric power. Corrective action supplied by this pilot was to apply rudder and to hold aileron. Displacement of the aircraft, even so slightly as to be unnoticed at first, caused the Dutch roll to start, but once the proper recovery is used or the yaw damper is turned on, the oscillations stop. The danger in the maneuver is in not being entirely familiar with its characteristics and in not knowing the proper corrective action.

Control Without Spoilers

During a series of descending turns, rates of roll with full spoiler action and with either or both sets of spoilers inoperative was tried. Control without spoilers is positive but somewhat sluggish and controlling the aircraft without the use of spoilers is an emergency measure which should be practiced frequently from time to time to maintain proficiency.

At 15,000 ft. the aircraft was slowed and put into landing configuration. With power at idle, an airspeed bleed-

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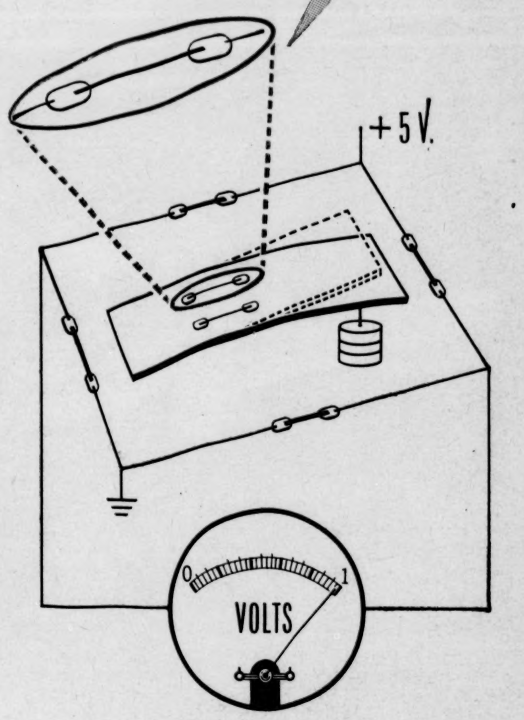

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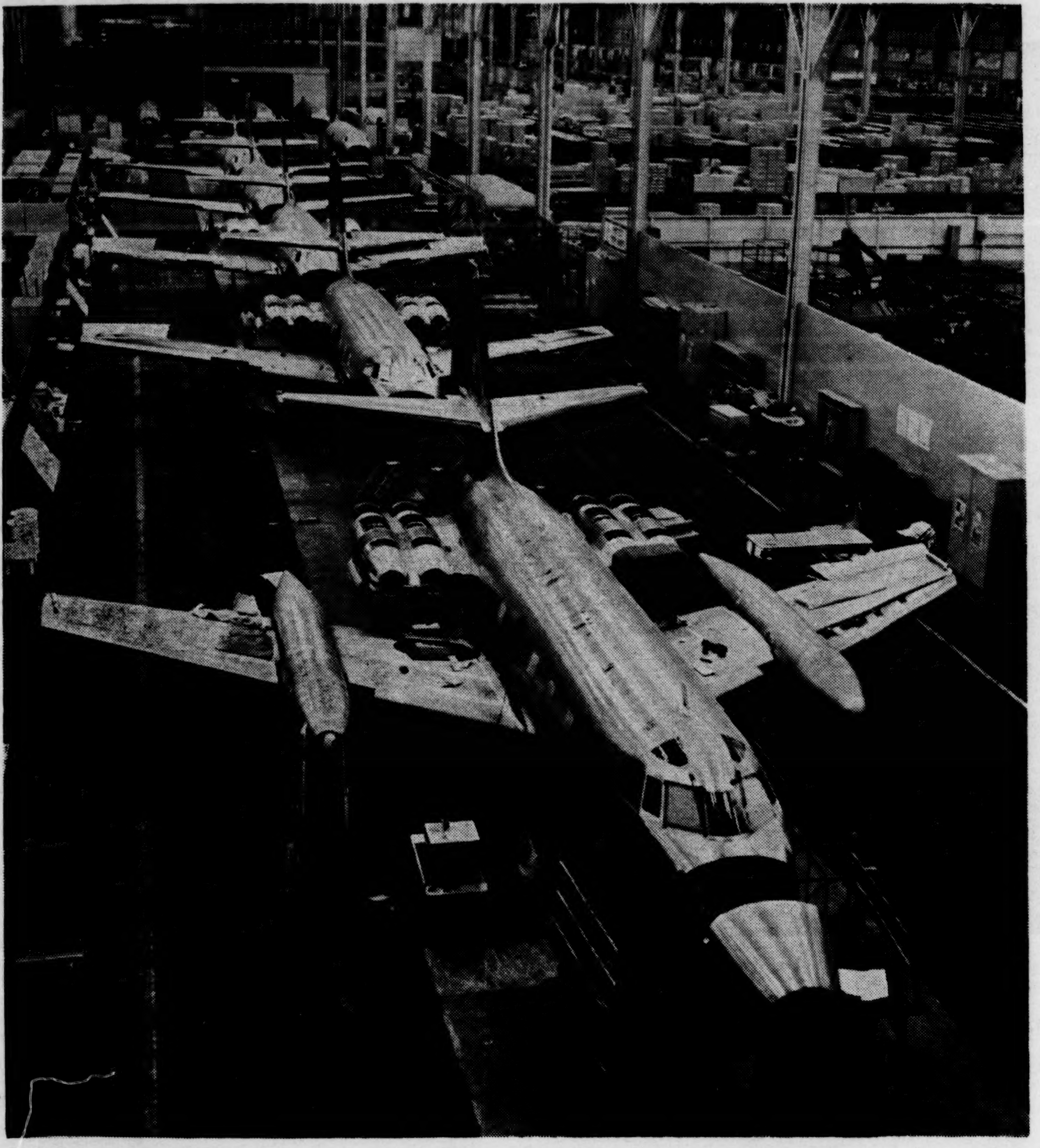

JetStars Move Down Production Line

Lockheed JetStars move down the production line at the company's Marietta, Ga., plant. Deliveries are scheduled to begin next summer on commercial orders, and the first of six Military Air Transport Service special air mission C-140 JetStars is to be delivered in September under $9,400,000 contract. MATS ordered another five JetStars for checking navaids. Lockheed has five of the aircraft, powered by four Pratt & Whitney JT12A-6 turbojets, in an FAA certification program. Others are entering company flight testing.

off rate of 1 kt./sec. was established to assure that no incremental g force was applied. Buffet was ample, occurring at about 113 kt. followed by a very docile stall at an indicated airspeed of 98 kt. A mechanical stick shaker actuated at about 115 kt. The 720B exhibited no tendency to fall off on a wing nor were there any excessive directional oscillations.

Acceleration was timed after the aircraft was cleaned up. While maintaining 15,000 ft., maximum continuous power was applied. Timing was started when the aircraft passed through 200 kt., and the acceleration to 300 kt. took 35 sec. Again, the aircraft was some 60,000 lb. under its maximum weight, but this indicates the machine's climb potential at this altitude. A pilot gleans that this is an aircraft with more reserve power than is usually available in transports.

Longitudinal pitch changes caused by spoiler actuation were tried in order to demonstrate how landings can be accomplished with a jammed stabilizer. Two switches on the overhead panel guarded to the "on" position will deactivate either the inboard or outboard spoilers. With the inboards inoperative, activation of the speed brake handle causes the outboard spoilers to be deployed, producing a nose-down pitching moment. Opening the switch on the outboards causes a nose-up pitching moment. When used in combination with at least 20 deg. of flaps, interplay between the spoiler activation switches and the speed brake handle produces effective longitudinal trim changes sufficient to enable a landing to be made.

Asymmetric power with one and two engines on the same side cut back to idle, illustrated that ample power was available to continue flight and that rudder control is sufficient for all normal maneuvers. Rudder force gradient, however, is not positive, but appears to be almost flat after the initial 40-lb. force is applied to bring the rudder boost into play with the yaw damper cut in. Without the yaw damper, 12 lb. of pressure is required.

Result is that with sudden power loss, a marked tendency exists to apply too much corrective rudder. Also, in maneuvering the aircraft, too much rudder can easily be applied resulting in uncoordinated maneuvers. This could lead to Dutch roll at altitude. Without a positive gradient, reference must be made to the instruments to maintain coordinated flight. Rudder force gradient, built to airline specifications, is not without compensation though. Turns with one and two engines out can be made comfortably without undue strain on the pilot's legs and without the need for constant trim.

Flying the 720B on instruments proved to be a pleasant experience. An overcast moved in at 12,000 ft. during the flight necessitating an instrument letdown to about 3,000 ft. Following Seattle Approach Control's instructions, a holding pattern was maintained for about 15 min., following which a standard radar monitored descent was made. Throughout the letdown, 30 deg. of bank was used. Ease of operation was apparent and the American Airlines' flight instrument arrangement proved to be conducive to a minimum of confusion. The descent through light icing and moderate turbulence proved to be free from difficulty. Trim changes proved to be nominal with changing power and speed.

Three landings were made on this flight with two being performed from the left seat by this writer and the last done by Maier demonstrating a "hands off" touchdown. Reference speed V_{ref} for over-the-fence speed at a gross weight of about 125,000 lb. was 117 kt. The pattern was flown at about 145 kt. with airspeed reduced to 125-130 kt. on the final phase.

Two characteristics have to be kept in mind when landing the 720B:

- **Lateral overcontrol** on the final approach is easily induced by the pilot if corrective action is held too long. As in the Dutch roll description, the inertia of the aircraft makes it necessary that corrective action applied to pick up a wing not be held until motion starts. If a wing drops slightly due to a gust, opposite aileron is applied but the correction removed before opposite roll starts. Once the proper action and reaction is learned, lateral control is not difficult but the uninitiated pilot may work overtime on the ailerons unless the aircraft reactions are lead with corrective action.
- **Flareout is initiated** as with any aircraft on landing, but the aircraft is not held off as speed decays. Rather, a constant attitude is maintained. The relative angle is not increased. If an attempt is made to hold the aircraft off, a bad landing will result because the main gear is aft of the center of rota-

Computer-operated laboratory model of pilot's display of available landing sites within the realm of safe re-entry.

FAST THINKING for spacecraft pilots is the development objective of the Bendix Energy Management System Project being carried out for WADD, ARDC, United States Air Force. By means of an airborne computer-operated electronic display, a pilot will see the continually shrinking area of targets and landing sites which he can reach without exceeding the acceleration or heating constraints of safe flight. Career opportunities in such advanced projects are available to engineers who would like to direct their energies most effectively.

BENDIX SYSTEMS DIVISION
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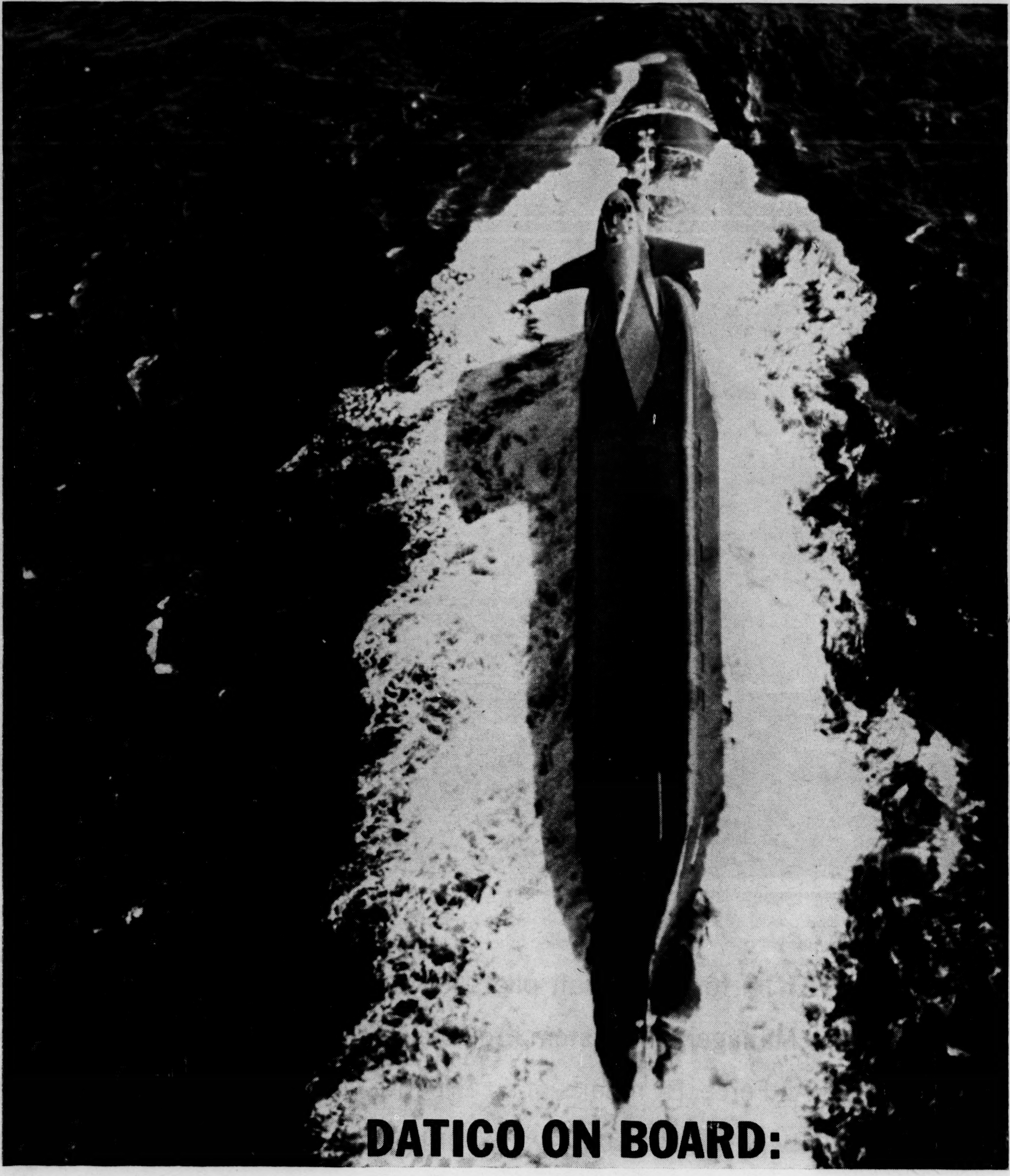

DATICO ON BOARD:
SIX MONTHS FROM CONTRACT TO COUNTDOWN

Just six months following contract award, Northrop began deliveries of Datico automatic checkout equipment for use in the Navy's Polaris Fleet Ballistic Missile program. Datico is used in factory, depot, tender, and submarine operations.

Datico is a digital automatic tape checkout system with a wide variety of applications. Its successful integration by Northrop into the Polaris and other major weapons systems demonstrates that the same basic Datico equipment can be used at all levels of maintenance and operation, utilizing the same test standards and methods and operated by personnel with the same basic training.

Northrop is at work on more advanced versions of Datico to extend its capability to an even wider range of military and industrial systems.

NORTRONICS
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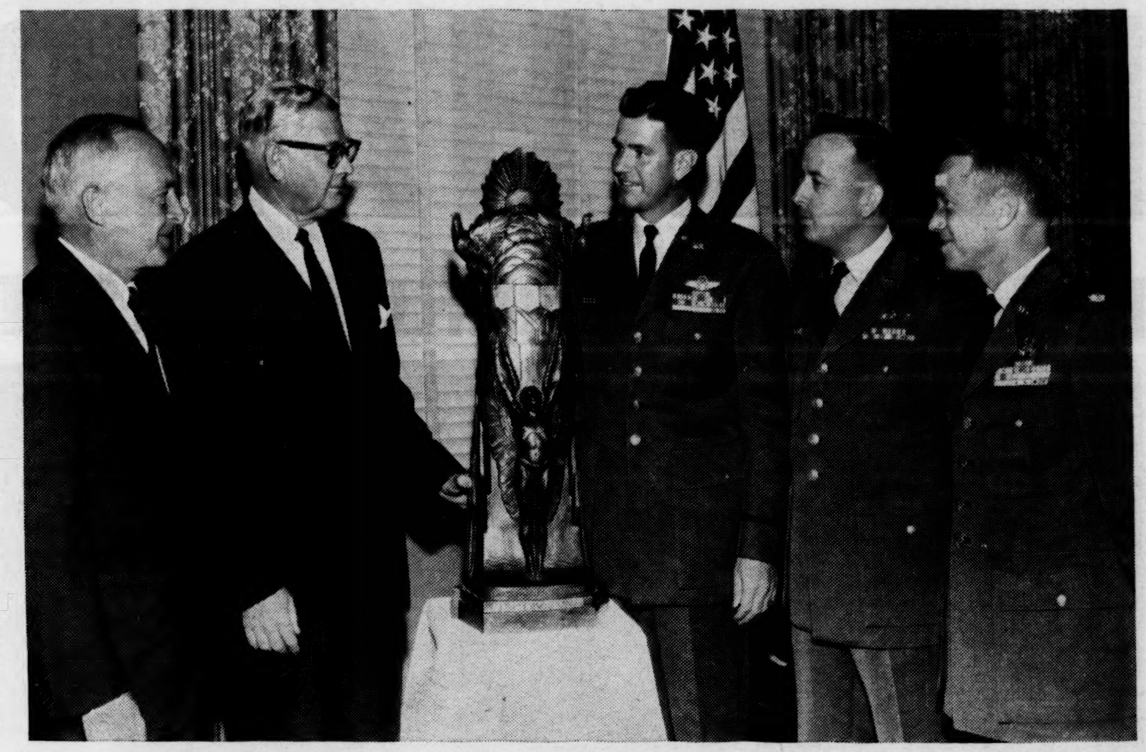
tion and holding off results in driving the main gear into the runway. Consistently good landings can be made by allowing the aircraft to settle onto the runway while maintaining the same attitude that was established on the approach.

The third landing was executed by Maier from the right seat. With only minor corrections applied by thumb pressure to the control yoke on final approach, the 720B came to within about 20 ft. above the runway. At this point, Maier cut the power and allowed the aircraft to settle itself onto the runway without further assistance. Although not as smooth as the assisted landings made, this demonstration graphically illustrated that too much effort on the part of a pilot can make the aircraft difficult to land.

After about 3 hr. of flight, the aircraft was taxied back to Boeing's Commercial Flight Center. Ground handling was conducted without difficulty, with visibility as good as that experienced in any large aircraft.



SAC B-58 Crew Receives Thompson Trophy

B-58 crew members of Strategic Air Command's 19th Air Division are awarded the Thompson Trophy for their 1,284-mph. performance over a 1,000-km. closed course, setting a new world record for this event. Shown left to right are August Esenweing, executive vice president of Convair, the B-58's manufacturer; Benjamin Chidlaw, executive vice president of Thompson Ramo Wooldridge, sponsors of the trophy, Maj. Harold Confer, pilot of the B-58, Capt. Howard Bialas, defensive systems operator, and Maj. Richard Weir, navigator (AW Mar. 6, p. 37).

PRODUCTION BRIEFING

Lockheed Aircraft Corp.'s first P3V-1 ASW aircraft rolled off its California Division assembly line recently. Powered by four Allison turboprop engines, the 400-mph.-plus aircraft will begin flight testing soon.

Belock Instrument Corp., College Point, N. Y., has received a $950,000 Navy contract for manufacture of unspecified components for the Asroc (anti-submarine rocket) program.

Curtiss-Wright Propeller Division, Caldwell, N. J., will build mechanical variable exhaust nozzle control equipment for the General Electric J85-5 turbojet engine. The $1-million contract is for controls on engines powering the Northrop T-38 jet trainer.

Twin Coach Co., Buffalo, N. Y., will produce fins, rudders and spoiler units for the Boeing C-135 jet cargo aircraft under $1.8-million contract. Production under the contract extends from April, 1961, to June, 1962.

Grumman will build additional W2F-1 carrier-based early-warning aircraft under a $38-million Bureau of Weapons contract. The W2F, powered by two Allison T56-A8 turboprops, is designed to replace the smaller piston-engine Grumman WF-2 as fleet early-warning aircraft.

Beech Aircraft Corp. has received a supplementary contract totaling $1.7 million from U. S. Army for additional production of Model 1025 target drones, extending this work until February, 1962. Model 1025 drone is Army's version of the Navy KDB-1 missile target.

Southwest Airmotive Corp., Dallas, Tex., has received a three-year contract covering helicopter engine overhaul from U. S. Army Transportation Materiel Command, St. Louis, Mo. Franklin O-335-5 engines for Bell H-13s and O-335-6 engines for Hiller H-23s will go on the Southwest Airmotive overhaul lines in May and contract calls for minimum of 135 engines to be overhauled in the first four months of work. Contract marks Southwest Airmotive's entry into Army aircraft engines overhaul.

Convair Division of General Dynamics Corp. has received a $566,126 USAF Air Research and Development Command contract to develop and test a pneumatic flight control system for high performance aircraft and missiles. The two-year effort will be conducted at San Diego. The flight control system is to operate in the presence of high temperatures and high nuclear radiation fluxes. Present hydraulic systems are inadequate in such an environment.

Advanced Technology Laboratories, Mountain View, Calif., received a letter contract from Boeing Airplane Co. to develop prototype sensor devices for measuring skin temperatures in the Dyna-Soar manned space glider. System will give the pilot critical temperature data during the glide into the earth's atmosphere and Boeing calls it one of the most important systems in the glider development program. The $86,000 contract also calls for the development of a method for installation of the sensors.

AiResearch Mfg. Co. (Garrett Corp.) has been awarded a three-year contract by the Space and Information Systems Division of North American Aviation, Inc. to investigate thermal and atmospherical control of space vehicles. AiResearch will study the requirements, design concepts and integration of environmental control systems.

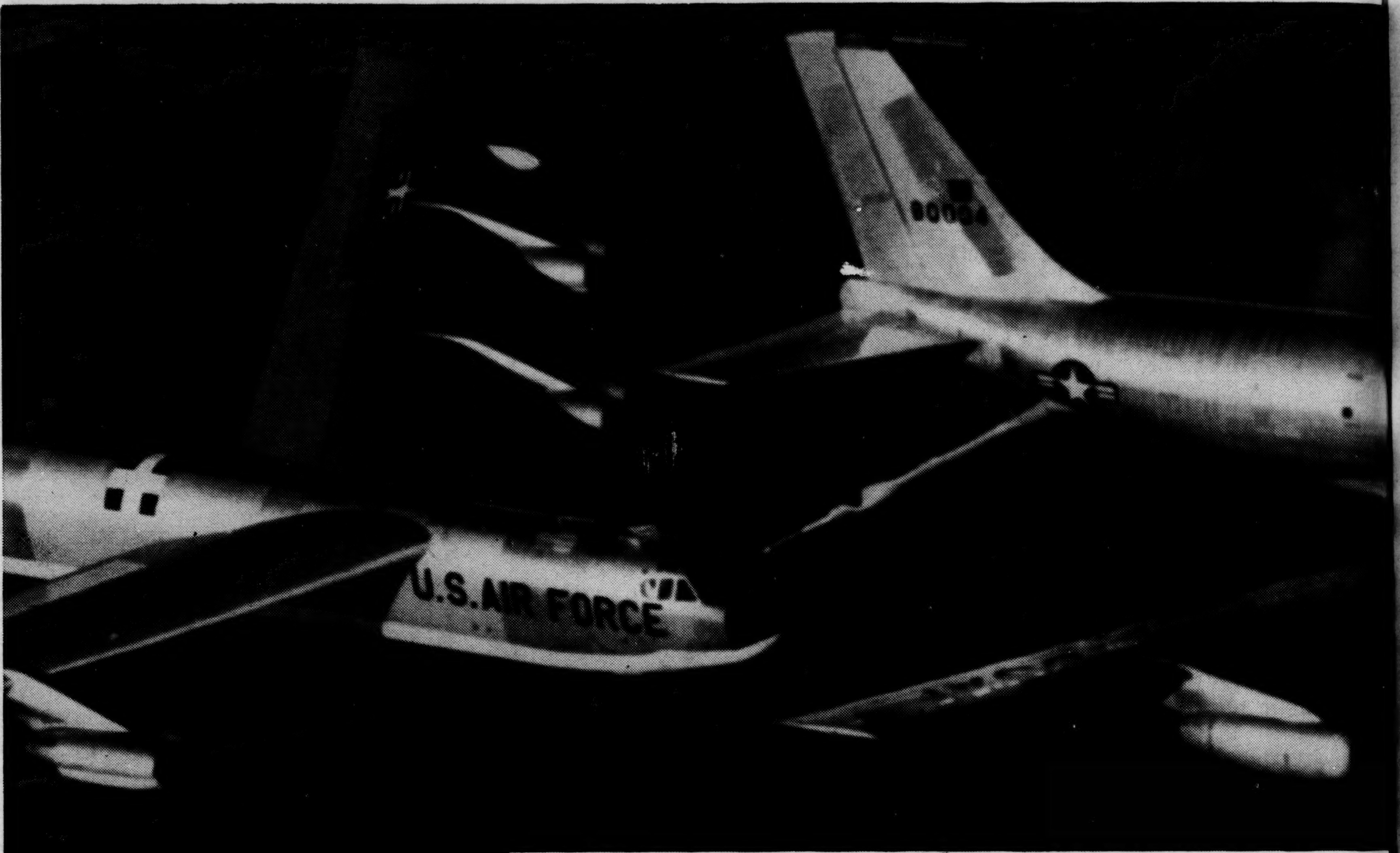
Nortronics Division of the Northrop Corp. has formed a marine equipment department to develop and produce periscopes, radiometric sextants, stabilization computers, and maritime navigation plotting equipment. The new department will operate in Norwood, Mass.

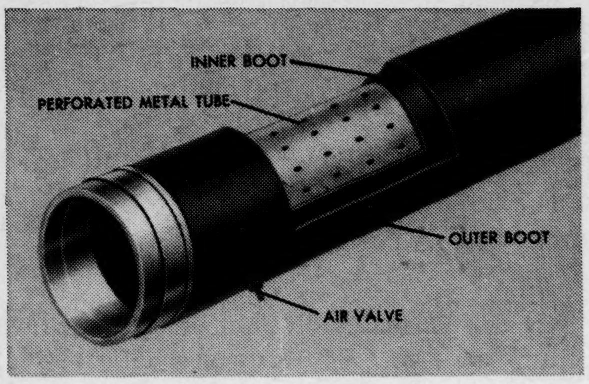
Kearfott Division of General Precision, Inc., Little Falls, N. J., has received contracts totaling $5,225,300 from Convair Division of General Dynamics, Inc., for follow-on production of precision rate integrating gyros for the Atlas.

General Electric Co.'s $15.5-million Missile Trajectory Measurement System, now being developed for the Air Force under ARDC contract, will use microwave as its primary communications link.

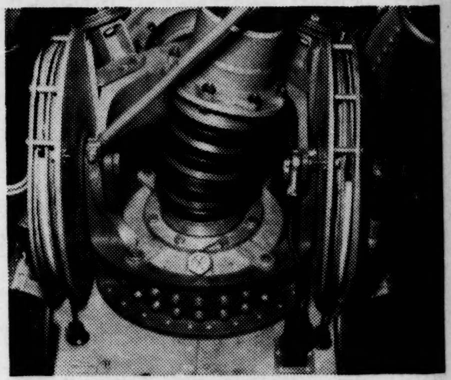
FUEL HANDLING

B.F. GOODRICH PRODUCES THE ANSWERS





SURGE BOOTS—absorb hydraulic shock.



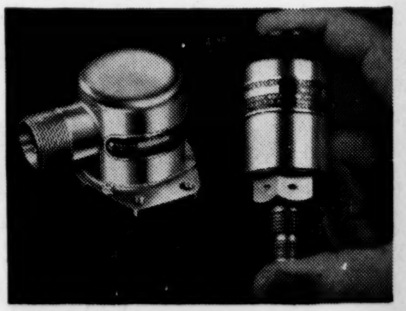
FLEXIBLE CONNECTORS—for internal fuel lines.

The aerial refueling system on the U. S. Air Force KC-135 jet tanker delivers fuel at an extremely high flow-rate—yet must disconnect instantly when required.

To take the tremendous shock pressure when flow is interrupted, B.F.Goodrich designed and built for Boeing a double-walled surge boot to carry fuel in the flying boom extension. A pressurized air cushion between the walls of the boot dampens shock loads, permits fast refueling with safety.

B.F.Goodrich designs and produces special products for a wide range of fueling requirements—surge boots, flexible fuel line connectors, fuel cells, hose, vapor barriers, and others for aircraft...motor cases, insulator liners, and solid propellants for rockets and missiles. For help in *your* applications check *B.F.Goodrich Aviation Products, a division of The B.F.Goodrich Company, Dept., AW-3B, Akron, Ohio.*

PRESSURE SWITCHES—BFG switches actuated by precision, Omega-design bellows perform many critical functions on jet engines such as indicating adequate fuel pressure, actuating afterburner igniters and unlocking nozzle area controls.



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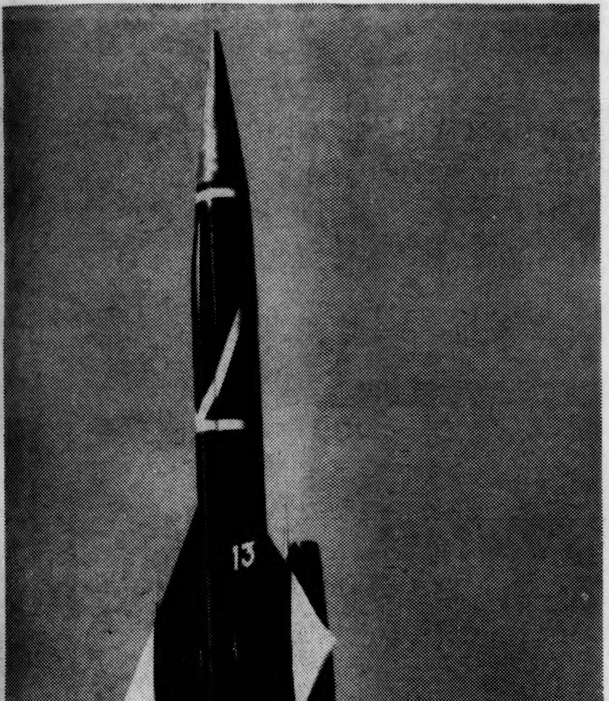
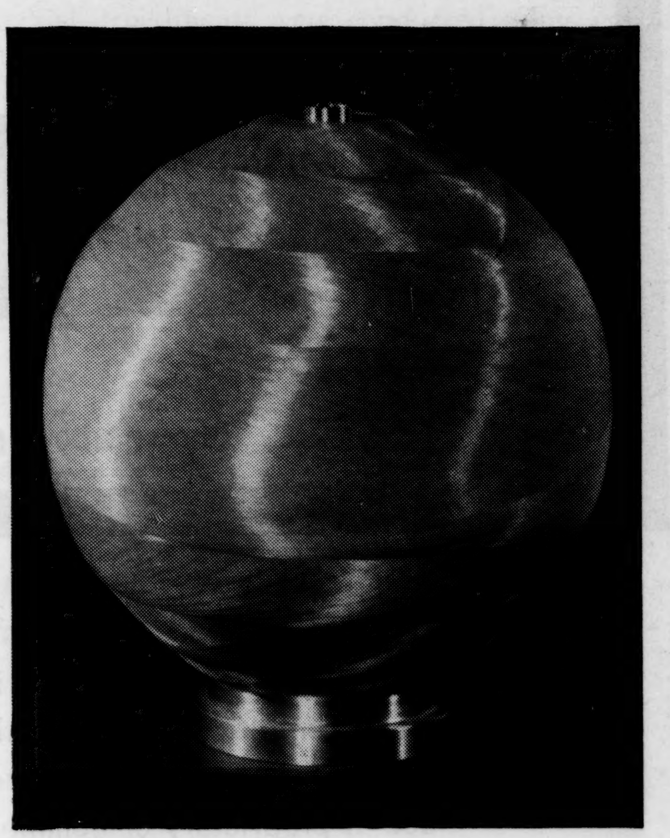


EXPULSION DIAPHRAGM—BFG supplies a special flexible diaphragm mounted in the fuel cavity of the Bomarc supersonic area defense missile. Diaphragm expels hydrocarbon fuels under pressure to external ram-jet engines.

U.S. AIR FORCE

WEIGHT-SAVING FLEXIBLE FUEL CELLS—This T-38 twin-jet trainer, made by Northrop, is one of many current aircraft using BFG fuel cells. Constructed with special fuel-resistant compounds, these cells are strong and lightweight. BFG fuel cell manufacturing is backed by complete development and test facilities.



SOLID-FUELED ROCKET MOTOR CASES—BFG offers complete capability in filament-wound rocket motor cases—also insulators. These glass fiber reinforced plastic structures are lightweight, strong, and are produced in many sizes and configurations.

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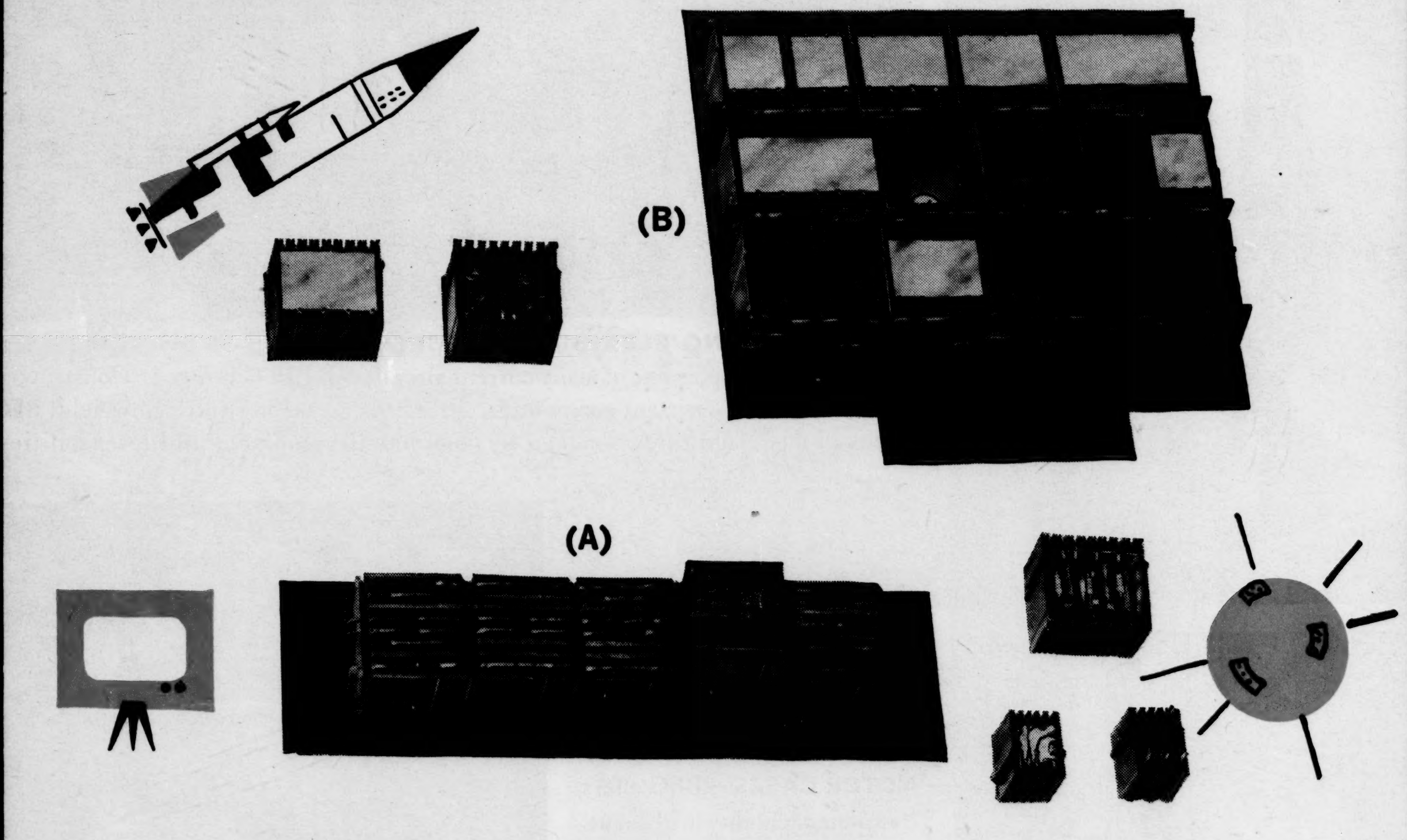

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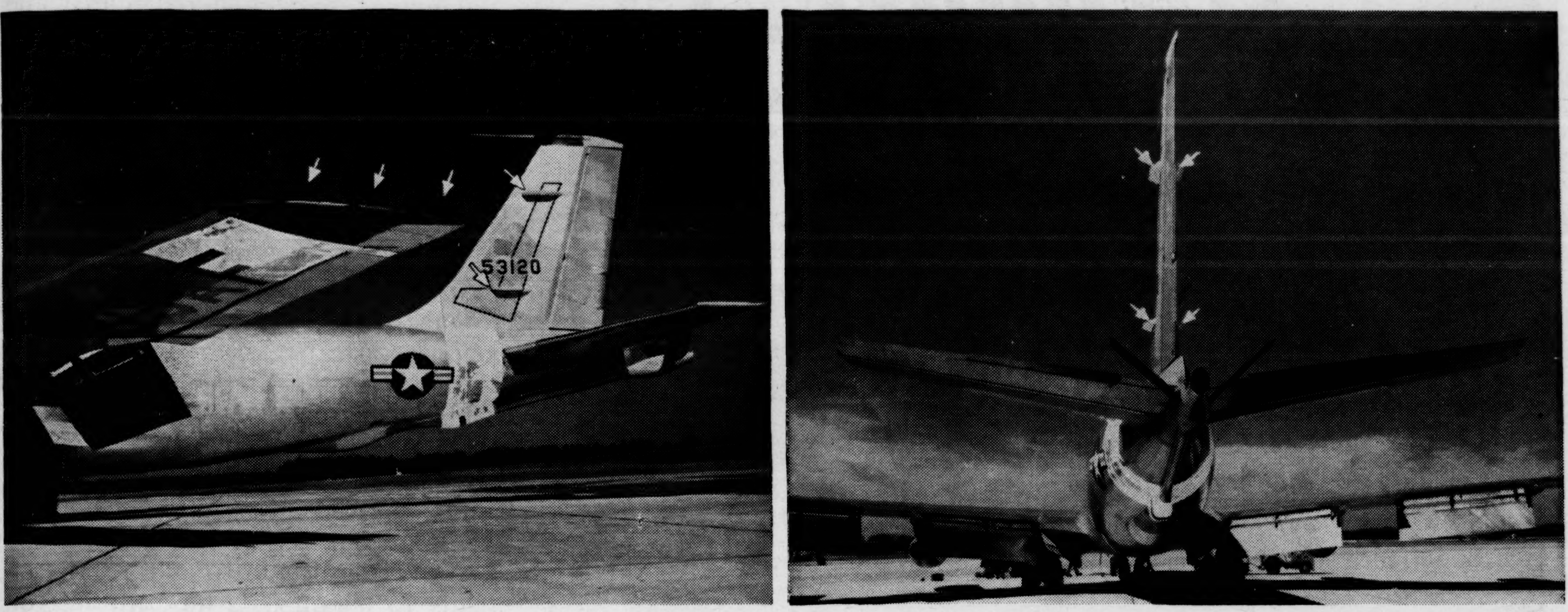


ANTENNA INSTALLATION on KC-135 jet tanker used in recent tests of ionospheric scatter for ground-air service, which demonstrated that teletype communications out to 1,500 mi. could be obtained at VHF frequencies. Tests were conducted by Air Force Cambridge Research Laboratories. For reception, three-element array is installed on each wing tip, providing space diversity reception. For transmitting, antenna arrays are mounted on vertical stabilizer and on aircraft's nose.

KC-135 Tests Ionospheric Scatter VHF

By Philip J. Klass

Feasibility of using ionospheric scatter for two-way ground-air communications at VHF frequencies over distances up to 1,500 mi. has been demonstrated by a series of recent tests conducted by Air Force Cambridge Research Laboratories.

During a period of auroral disturbance which had blacked out conventional HF radio, an AFCRL station near Bedford, Mass., maintained teletype communications with a KC-135 turbojet tanker flying more than 1,000 mi. north of the station.

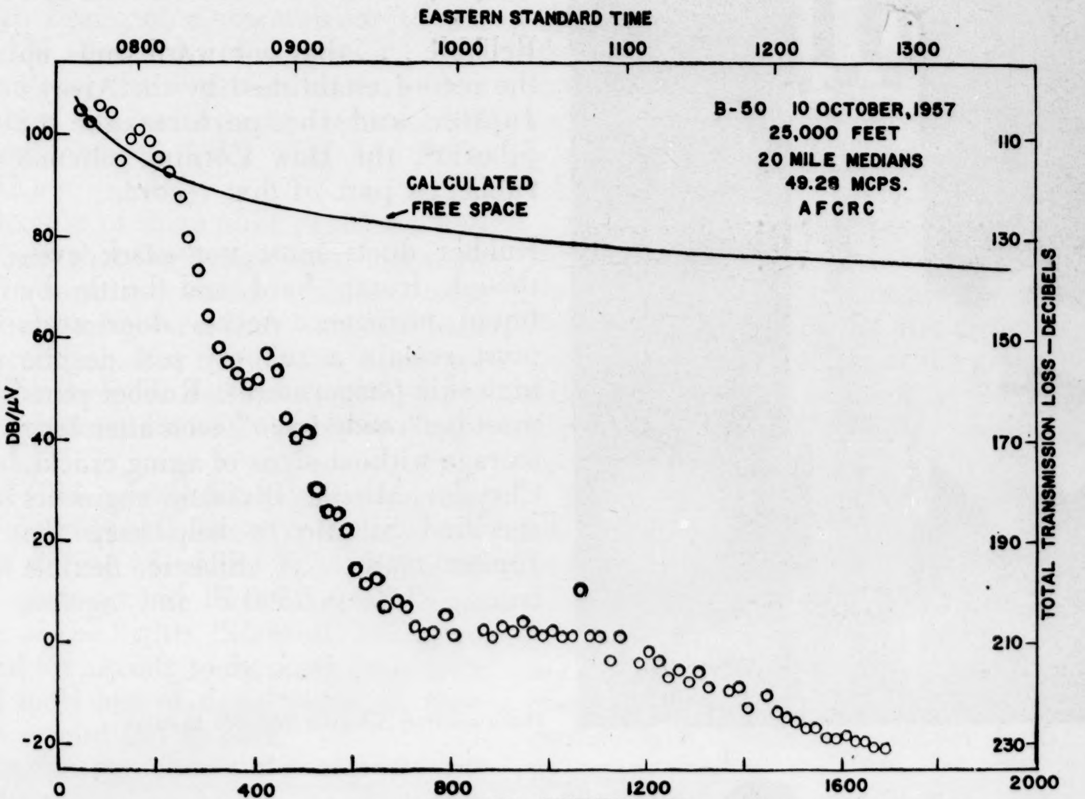
Development Tests

These tests are the latest in a series of developments which emphasize that tropospheric and ionospheric scatter techniques are not limited to point-to-point service as a means for using VHF and UHF over distances far beyond line-of-sight ranges. The others include:

- **Pan American World Airways** and U. S. Navy have conducted two-way ground-air voice communications at VHF between California and Hawaii, a distance of 2,600 mi., using "radio ducts" produced by temperature inversion, and by tropospheric scatter for lesser distances (AW Feb. 6, p. 50). Pan American pioneered the ground-air use of tropo-scatter originally with a station in Ireland (AW Jan. 18, 1960, p. 46).
- **Aeronautical Radio, Inc.** has achieved two-way VHF voice communications with aircraft at distances up to 558 stat. mi. using a tropo-scatter installation atop Mt. Washington in New Hampshire (AW Feb. 6, p. 95).
- **Federal Aviation Agency** plans to install two experimental tropo-scatter stations in Greenland and Newfoundland to extend the original PAA tests and coverage.

The recent AFCRL tests, using a specially outfitted KC-135, showed that 60 word-per-minute teletype service with low error rate, both ground-to-air and air-to-ground, can be obtained consistently out to 1,200 mi. by ionospheric scatter. Ranges out to 1,500 mi. can be obtained under favorable conditions, or at the expense of a modest increase in error rate, AFCRL tests indicate. Experiments were conducted using a frequency of about 50 mc.

When ionospheric and tropospheric scatter techniques were developed less than a decade ago, demolishing the previous line-of-sight range limits of VHF and UHF, they were considered a tech-



POSSIBILITY of two-way ground-air ionospheric scatter communications system was first suggested by results of field strength measurement tests conducted by Air Force Cambridge Research Laboratories in 1957 in a B-50. Measurements were made at 49.28 mc.

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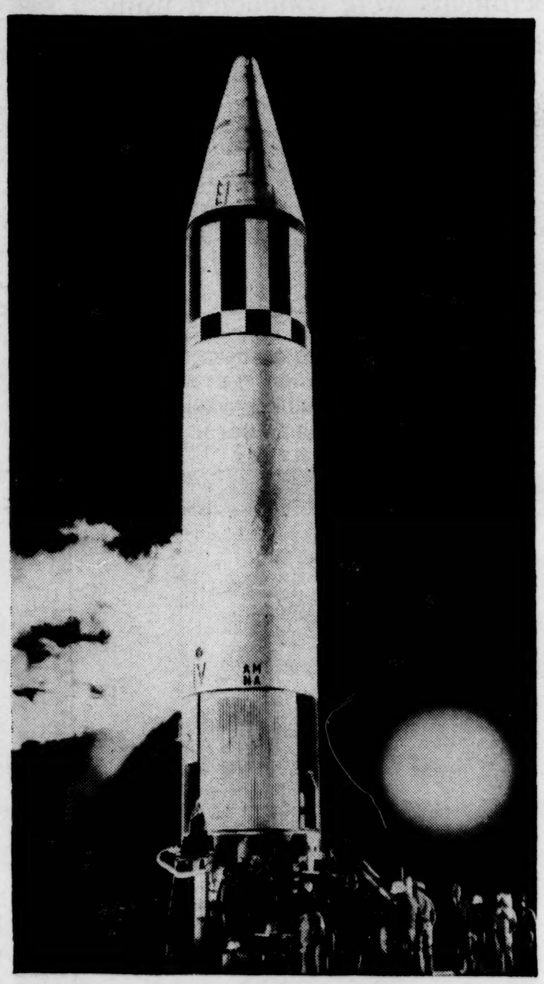

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Photo courtesy Chrysler Missiles Division

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nological breakthrough in point-to-point communications. Tropo-scatter could provide wideband voice service out to distances of several hundred miles, while ionospheric scatter provided narrowband service out to distances of about 1,000 mi. But the extremely high-powered transmitters and large antennas required, particularly for ionospheric scatter, made it seem unlikely that either could be used for ground-air communications.

In 1957, AFCRL scientists decided to investigate the possibility of using ionospheric scatter, spurred by the needs of the Strategic Air Command for reliable communications with its aircraft operating in the Arctic in the face of blackout of normal HF radio service during sun spot disturbances.

Using a specially instrumented B-50, AFCRL scientists first made a series of flights to obtain data on path loss of signal strength as a function of distance and altitude. From these measurements, AFCRL scientists concluded that there was a good possibility that two-way ground-air teletype service could be provided, and plans were laid for the subsequent operational tests in a KC-135.

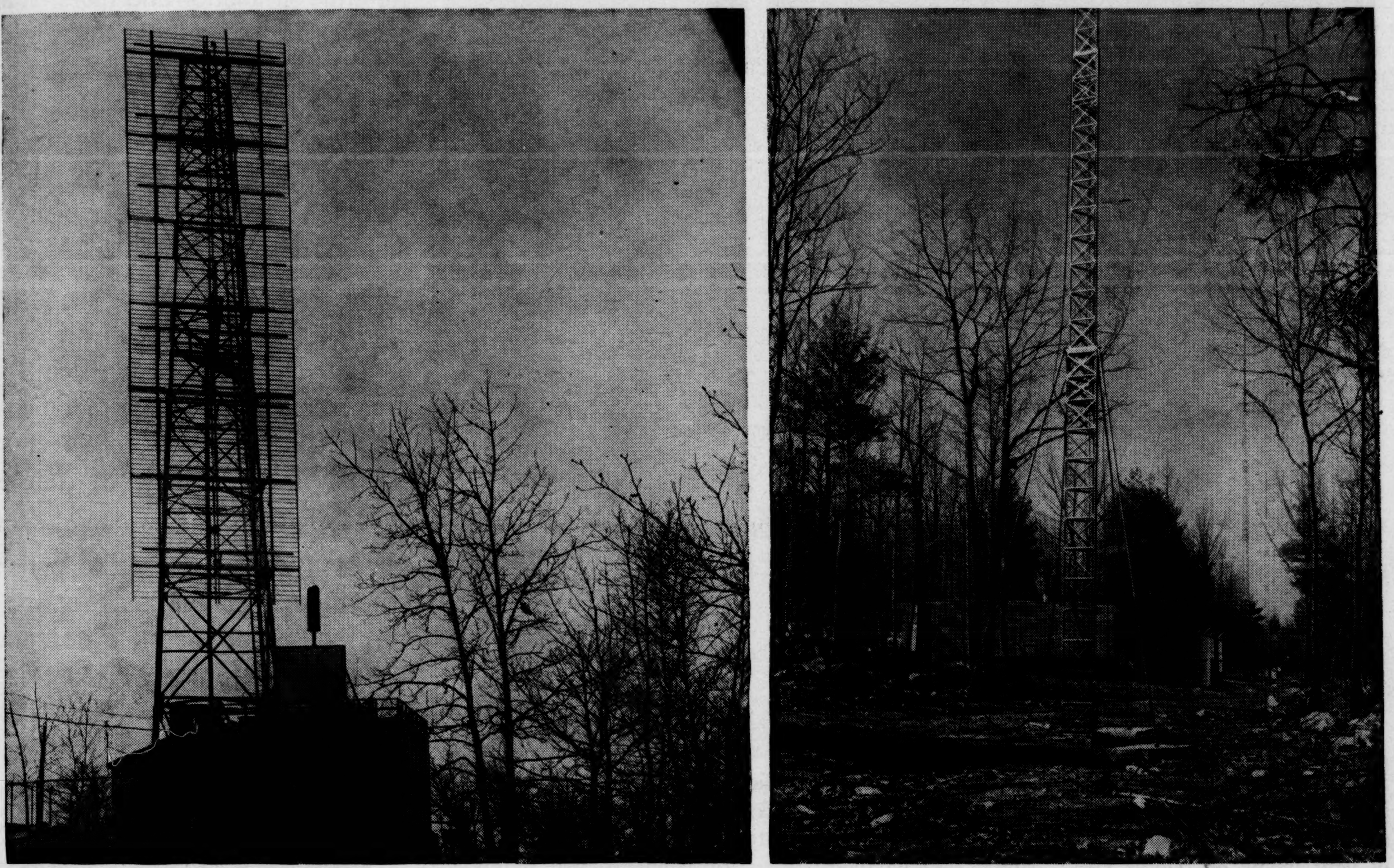
Airborne Installation

In shifting one of the two terminals from a ground station to an airplane there are a number of problems that arise. The ground terminal can no longer use the same high-gain, highly directional antennas, because the aircraft is in motion and its position may not be known in advance. For aerodynamic reasons, the aircraft must operate with relatively small low-gain antennas and it cannot carry a transmitter which is as powerful as a ground station's transmitter.

To make up for these limitations, AFCRL scientists resorted to other techniques to boost performance. The ground station, located in Waltham, Mass., employed three-stage frequency diversity operation. The space/mark pulses transmitted were of 30 milliseconds duration. The first 10-millisecond segment of pulse was transmitted at one frequency, the second 10-millisecond segment was transmitted at a frequency offset 30 kc. from the first, and the third 10-millisecond segment was offset again by 30 kc. Ground transmitter power output was 50 kw. Transmitting antenna consisted of a vertically stacked dipole, with a gain of about 17 db., giving broad azimuth coverage, while compressing beam in vertical direction.

A separate receiving site was located at Littleton, Mass., about 20 mi. from the transmitter. Six receiving antennas and diversity receivers were used to provide six-fold space diversity reception.

The KC-135 also employed space diversity in its antenna installation. For



GROUND STATION ANTENNAS employed in ionospheric scatter ground-air communications tests include transmitting antenna (left), using a vertically stacked dipole which gives broad azimuth coverage but compresses radiation in vertical direction, and six receiving antennas, four of them visible in photo (right), which provide space diversity operation for receiving aircraft transmission.

receiving, a three-element array with a gain of about 6 db. was mounted on each wing tip. (See photo.) For transmitting, antennas with a gain of about 7 db. were mounted on either side of the aircraft's vertical stabilizer and nose, also providing dual space diversity.

The aircraft was outfitted with a 5-kw. transmitter, built by the Martin Co., and two 10-kw. units, one built by Continental Electronics and the other by AFCRL scientists. These are the most powerful transmitters ever operated aboard an aircraft, according to AFCRL scientists.

The aircraft was equipped with dual space and triple-diversity receivers, a seven-character teletype and converter. Conventional frequency shift keying (FSK) was employed, but using a frequency shift of 6 kc. to avoid problems of meteor trail reflection doppler shift. Band synchronous quasi-matched filter detection was used.

Flight Tests

Flight tests, which began in November 1959 and were completed last year, encountered considerable problems with noise in the receiving antennas produced by static discharge. Below the altitude of the tropopause (30,000 to 38,000 ft.), noise on the wing tip receiving antennas was 40-60 db. above normal ground background noise, dropping off sharply to 10-15 db. above ground background when the aircraft was above the tropopause altitude.

(The AFCRL scientists may have unwittingly selected a location and antenna configuration which serves as an effective static discharge device. In tests of a new type static discharge device developed by Stanford Research Institute, which bears some resemblance to the KC-135 antenna configuration, SRI found that the wing tips were an ideal location for discharging accumulated aircraft charge.) (AW Mar. 14, 1960, p. 52.)

Because of these noise problems, and the fact that the transmitting antennas in the nose and vertical stabilizer were relatively noise-free, they were also used for receiving. For this reason, it was not possible to carry out simultaneous two-way communications during a single flight.

AFCRL scientists conducted successful ground-to-air teletype communications during 18 of the KC-135 flights, and air-to-ground transmissions during nine of the flights. Standard procedure called for aircraft to fly north from Bedford until loss of signal occurred, then turn around and fly back.

Equipment aboard the aircraft, and at the ground terminals, recorded both signal level and the stream of received teletype characters for subsequent error-count analysis.

During one period of intense solar activity, which had blacked out HF communications, the KC-135 made a double run.

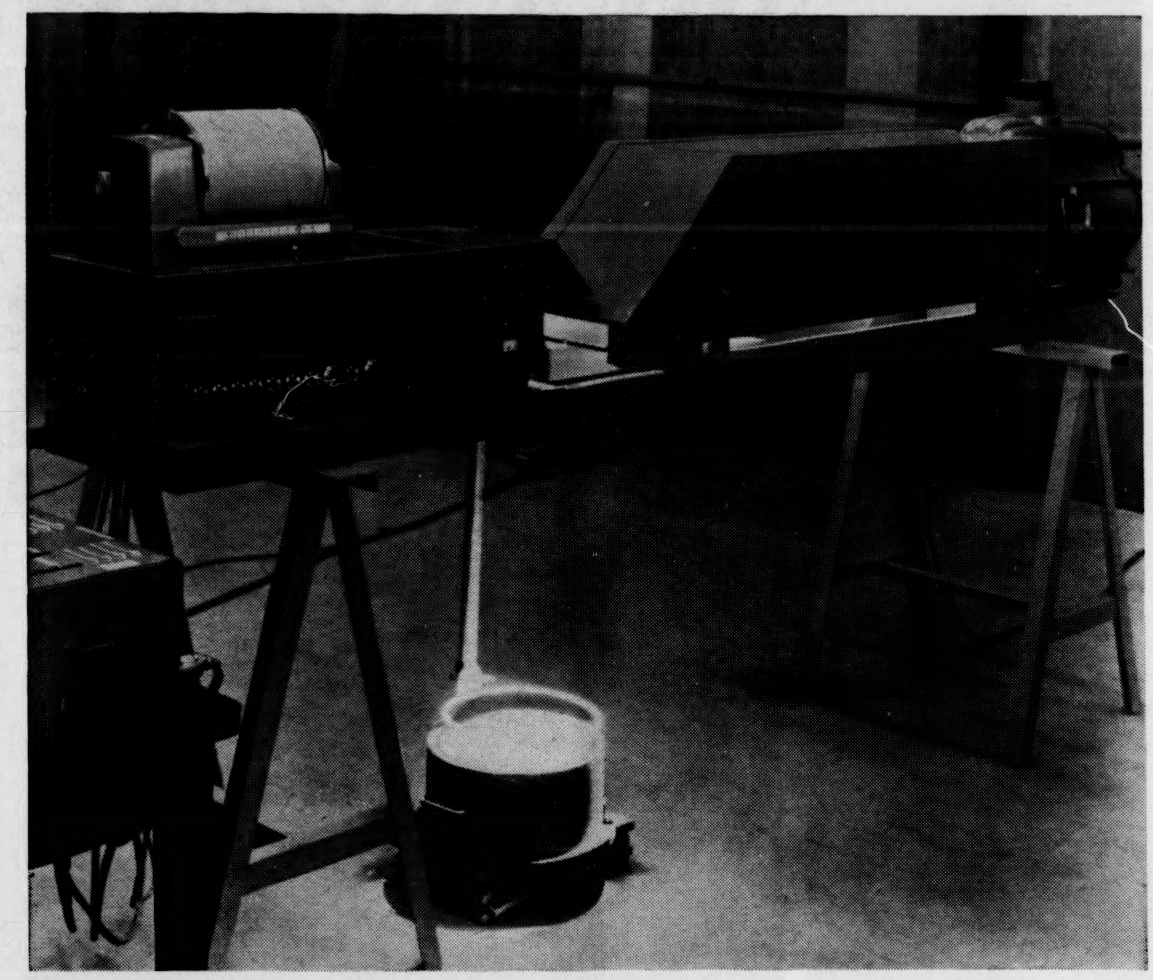
Communication was not only maintained out to nearly 1,500 mi., Aviation Week was told, but the signal was actually stronger than normal at distances beyond 800 mi.

Most feasible explanation of this phenomena is that the D-region of the ionosphere, which is believed to be responsible for scatter propagation, undergoes increased ionization during a solar storm.

AFCRL scientists already have ideas for improving system performance, if it should be adopted for operational use. With improved design of the airborne antennas and better siting of the ground receiving antennas, as much as 3 to 5 db. could be gained, AFCRL scientists say.

Raising the power level of the ground transmitter from the 50 kw. used in the tests to as much as 500 kw., which is now possible, would provide a major boost in performance. Improved cooling for the airborne transmitter, to enable it to deliver its full 10 kw. continuously, could add another 4 db. to system performance.

The AFCRL ionospheric scatter program was carried out under the project direction of Edward Dagle and Arnold Orange of the Electronics Research Directorate.



INFRARED SPECTROPHOTOMETER is a Perkin-Elmer modification used in Army terrain analyzer project. At left are high-voltage power supply and electronic racks. At right are carbon arc light source and adjustable mirror (in housing) to control angle of incidence of light falling on sample area. Sample and reference beams are compared and results recorded on roll chart.

Airborne Infrared Monitor Studied

U. S. Army is studying the feasibility of an airborne infrared monitor which will permit high-speed surveying of the ground below by continuous monitoring of the terrain's infrared reflectance values.

Officers said such data could be transmitted electronically to a remote intelligence center where technicians could derive accurate indications of the terrain structure and its suitability for heavy traffic, such as tanks, trucks and special weapons vehicles.

Study is under way at U. S. Army Engineers Waterways Experiment Station at Vicksburg, Miss. Army said if the military objectives are attained, the terrain analyzer project could prove practical in commercial applications in exploration for oil, mineral and other subsurface deposits.

Instrument involved in the tests was developed by Perkin-Elmer Corp., and is a modification of one of its standard spectrophotometers by equipping it with a carbon arc source and additional optics.

Intent is to establish diffuse reflectance characteristics of various types and conditions of soils and vegetations, such as slope and moisture. Sample plots of terrain types now are being analyzed with the Perkin-Elmer device to determine correlation between infrared reflectance and structural characteristics.

Current phase involves only ground-based instruments. If feasibility is proven, project will study development of smaller units for airborne use.

To assure maximum sensitivity, Perkin-Elmer engineers modified the instrument to make use of three detectors over a 0.25 to 5.00 micron area. Photomultiplier is used from 0.25 to 0.7 microns; lead-sulfide detector from 0.7 to 2.88 microns, and cooled indium-antimonide detector from 2.88 to 5.00 microns.

Scanning is automatic and varies in speed from 2 min. to 320 min. per spectral wavelength coverage. Detectors and optics are switched automatically during forward and reverse scan; split servo corrects for detector sensitivities and source characteristics and thus provides a constant reference channel signal.

In the modification, the optical system was altered to provide uniform collimated light on the terrain sample at angles of incidence from 35 to 70 deg. Double-beams system eliminates all atmospheric effects.

Phase differences between the three detectors and their pre-amplifiers are eliminated; coherent electronic rectifier is used to produce a d.c. output for the recorder and rectifier reference signal is automatically phase-shifted to keep it in phase with detector signal.

Re-entry simulation and material test services are two of the many activities now being conducted at Plasmadyne's hyperthermal test facility. One of the company's products, an arc plasma generator, is used to simulate the heat transfer conditions of hypersonic flight of missiles and satellites.

Other scientific disciplines undergoing investigation include: high temperature chemistry, hyperthermal gas dynamics, high intensity radiation in the visual and near visual spectrum, plasma physics and electro-magneto fluid dynamics.

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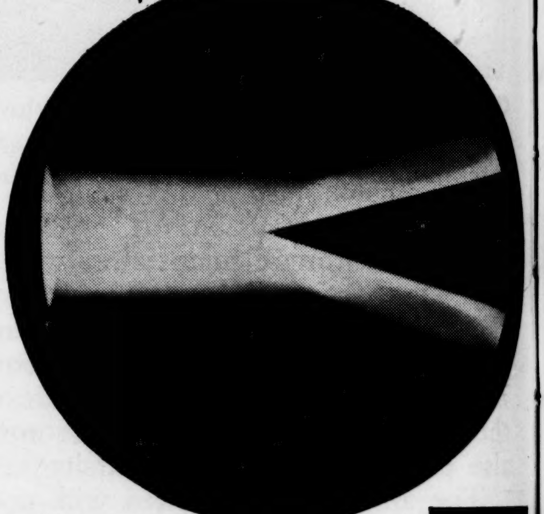
President



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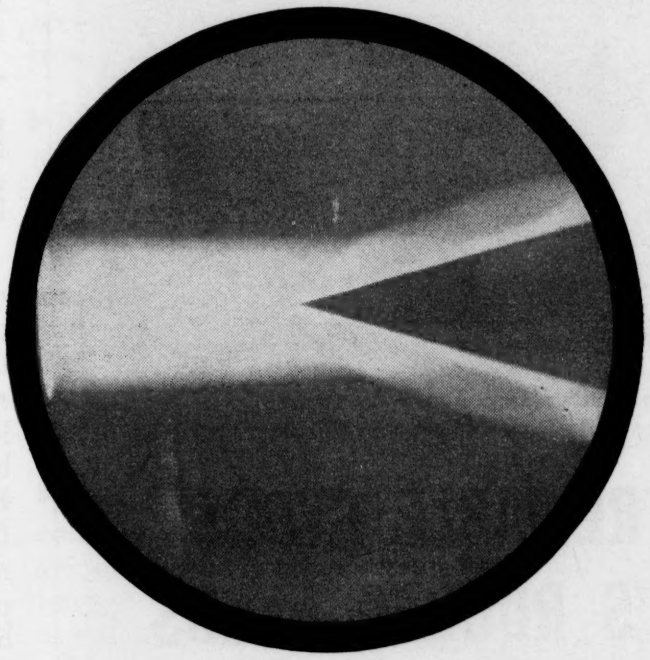

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ENGINEERING
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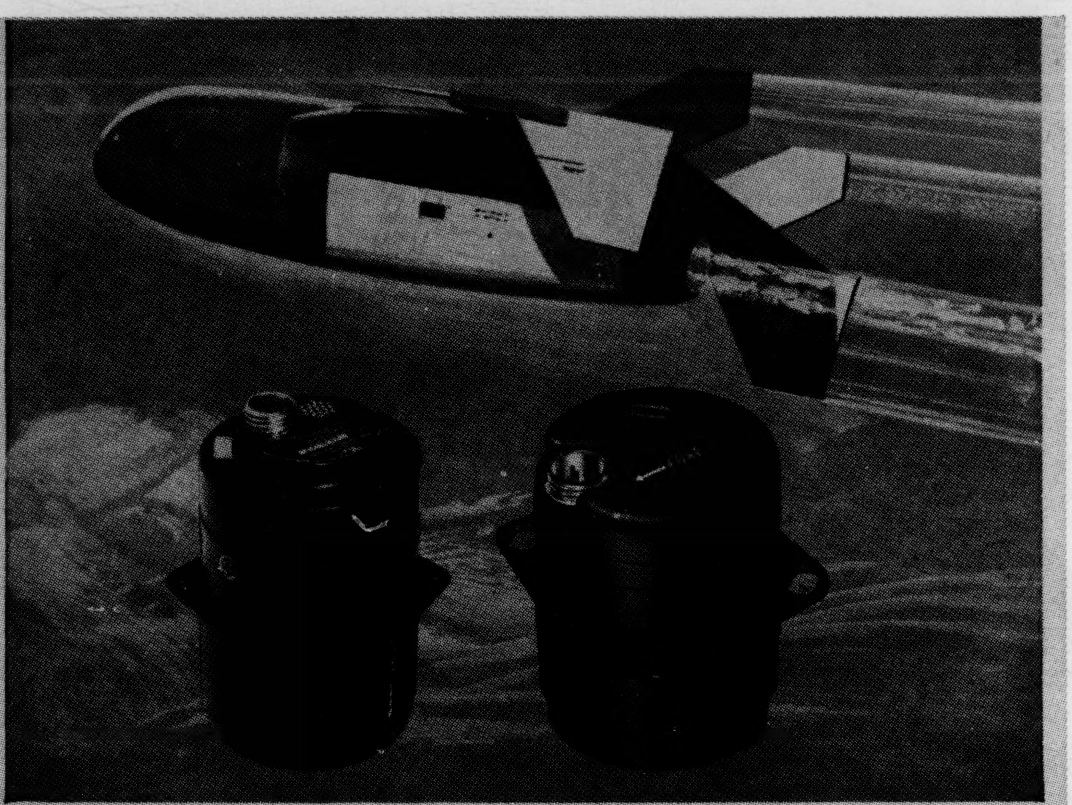

Bendix vertical and directional gyros contribute to accuracy and dependability of guidance system on United States Air Force (Green) Quail air-launched decoy missile manufactured by McDonnell Aircraft.

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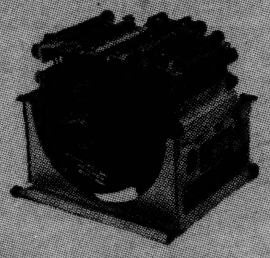
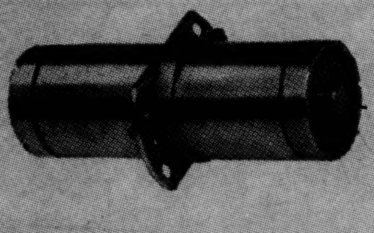


VERTICAL



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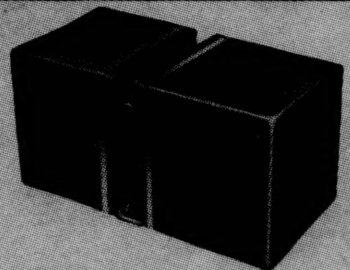

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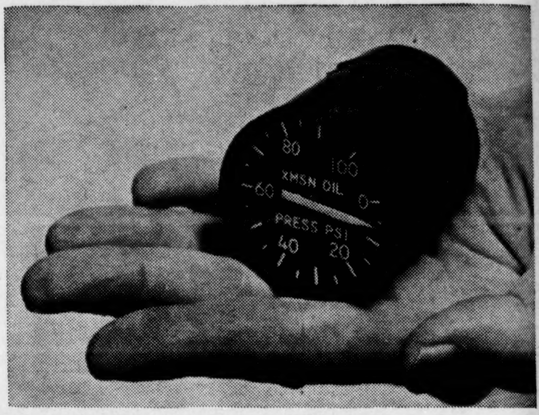

SIMMONDS multi-scan indicator, lightweight (12 oz., including rotary selector switch which is not shown here) and compact (2 in. dia., 3.8 in. deep), can monitor five areas of a system on one dial through multiple transducers. Unit shows only critical (highest or lowest) measurement; rotary selector switch or lighted panel with numerals then reveals which transducer is giving that measurement.

Multi-Scan Indicator Monitors Five Areas

New York—Multiple-transducer indicator, which can monitor five or more critical points on engine temperatures, oil pressures or hydraulic systems, and read out only the critical (highest or lowest) measurements on one dial, has been developed by Simmonds Precision Products, Inc., Tarrytown, N. Y. Vertol Chinook helicopter uses a Simmonds multi-scan indicator to check engine oil pressures at fore, aft and middle gear boxes, left and right engine oil pressures.

The unit, composed of an indicator, amplifier, transformer bridge and rotary selector switch, operates automatically. Signals from the transducers are compared with fixed reference voltages in the bridge; differences in phase and magnitude are amplified to drive a two phase motor, which in turn moves the indicator pointer on the face of the dial.

Indicator always shows the highest (or lowest, depending upon the system being monitored) measurement reported by the various sensors. In the first model built by Simmonds, a rotary selector switch is operated manually through five stops and at each stop, which is keyed to a specific transducer, the pointer indicates the measurement being taken by that sensor.

The stop at which the highest (or lowest) reading occurs is the critical area in the performance of that system and the pilot must then take appropriate action.

The second version of the unit has a button panel, which lights behind the numerals of the sensors. Mode of operation is identical with the first model, with the exception that panel numerals light automatically to indicate the critical transducer.

FILTER CENTER

▶ **Integrated Computer Elements Out**—First in a line of integrated digital computer circuits, called Micrologic elements (AW Apr. 11, p. 94), was announced as commercially available last week by Fairchild Semiconductor Corp. Micrologic elements are silicon substrates with injunctions and resistors diffused into them to form a single circuit function. These integrated circuits currently are housed on a six-lead version of a conventional transistor TO-5 header and contained within a TO-5 can. First element containing the equivalent of four transistors and two resistors is a 1-mc. flip-flop, priced at $120. It will be followed shortly by a gate element, then four other units—½ shift register, counter adapter, ½ adder and buffer—before the end of the year. Later production Micrologic lines will be squeezed into the smaller transistor TO-18 cases.

▶ **Douglas Avionics Expansion Delayed**—Breakoff in Douglas Aircraft's efforts to acquire a "substantial interest" in Midwestern Instruments, Inc., Tulsa, Okla., temporarily delays but does not stop the almost inevitable diversification of this aerospace frame manufacturer into avionics. Douglas is steadily increasing its in-house avionics capability. No fewer than five departments in its Missile and Space Systems Division now have special groups studying possible advanced special avionics products. The company also is reported to have privately talked acquisition with several electronics firms recently. Negotiations to buy into Midwestern were terminated, Douglas says, when the Tulsa producer of recording and data processing gear arranged a $1.8 million loan from Midwest Technical Development Corp.

▶ **TV Guided Air-to-Surface Missile**—An air-to-surface missile which could lock on a TV or visual image of a target is under study by the Hallamore Division of Siegler Corp. Pilot would select target visually or from TV display and aircraft-carried missile would home on this. Or, if the airborne vehicle were pilotless, a battlefield commander might select target from TV image relayed to him from the drone. Possible advantage of such a missile compared with the Navy's Bullpup might be in greater accuracy and increased aircraft escape time from lock-on to missile impact.

▶ **Pneumatic Digital Computer**—Kearfott is developing a pneumatic digital computer, expected to be capable of performing same functions as an electronic machine over temperature range from −100F to 2,000F. Kearfott has developed a pneumatic flip-flop which has a switching time of only 10 microseconds, operating from compressed air or gas. Company reports that it can package 2,000 such flip-flops in a volume of one cubic inch, including all interconnections. On this basis, company predicts it can build a medium-size pneumatic digital computer, complete with memory, in a 3-in. cube.

▶ **Transistor Sales Reported**—Semiconductor industry sold 12.1 million transistors in November, an increase of 54% over unit sales in November of previous year. Dollar value of November shipments was $25.4 million, an increase of only 12% over previous November, reflecting lower unit prices, according to figures released by Electronic Industries Association.

▶ **New High-Power Tropo-Scat Transmitter**—A 75-kw. tropospheric scatter transmitter, developed by Radio Engineering Laboratories, is expected to permit 400-500-mi.-long jumps between terminals, roughly twice the range of most existing tropo systems. Company says the amplified power of the new transmitter is seven times that of any FM tropo-scat transmitter ever built.

▶ **Signed on the Dotted Line**—Major contract awards recently announced by avionics manufacturers include the following:

- **Remington Rand Univac,** $3.6 million Navy contract for production of peripheral equipment for Naval Tactical Data System and continuing work on computer programing and system planning.
- **Republic Aviation Corp.,** $72,649 order from Raytheon for plastic radar reflectors for use with AN/SPC-51 shipboard missile guidance.
- **Westinghouse Electric Corp.** reports contract for $1 million from Boeing for electrical systems to be used on new 727 turbojet transport.
- **Cohu Electronics, Massa Division,** Hingham, Mass., $2½-million contract from Columbia University for production of new high-power sonar transducers for use in long-range submarine detection system.
- **Sperry Gyroscope Co.,** $11.5-million contract from Bell Telephone Laboratories for development and construction of high-power transmitters to be used in discriminating radar of Nike Zeus anti-ICBM missile system. Sperry developed Nike Zeus target tracking radar under an earlier $7.7-million contract. Company also has received authorization from North American to develop and manufacture a twin-gyro stabilized platform to serve as a heading and vertical reference in the B-70.

ENGINEERING
REPORT
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CAM COMPENSATOR

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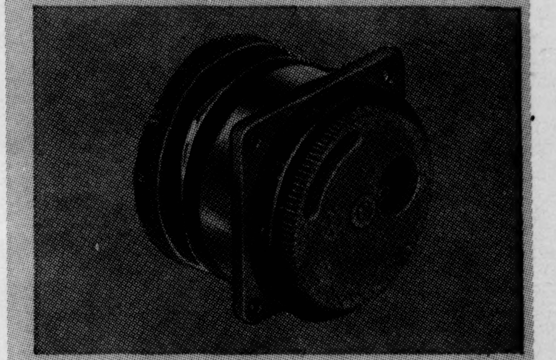

The type CP-20-A1 is a simple, entirely mechanical means of correcting an output data shaft in relation to either servo loop errors, sensing errors, or known environmental factors affecting the system. Eliminates need for adjusting remotely placed or inaccessible units. Ask for full details.

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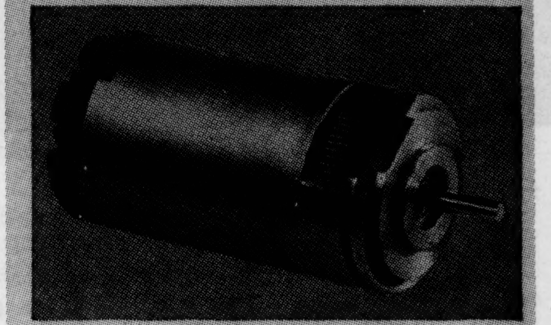

Here is a corrosion-resistant unit that features a rotatable housing construction along with a standard synchro mounting. Because housing, as well as shaft, can be rotated, an additional output can be introduced into control system circuitry. Stator housing assembly is driven by a gear accessible through a slot in the housing, thus translating mechanical differential inputs into electrical outputs.

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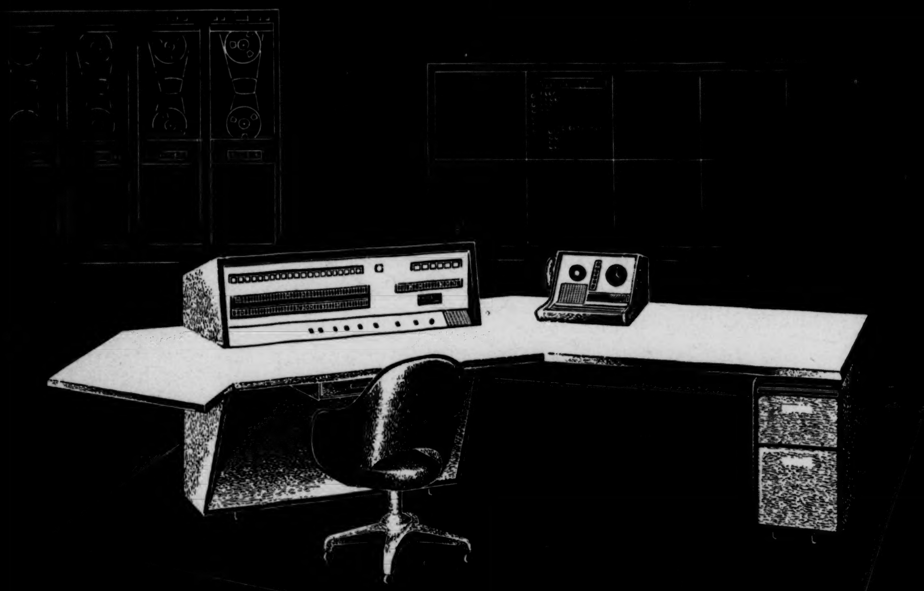

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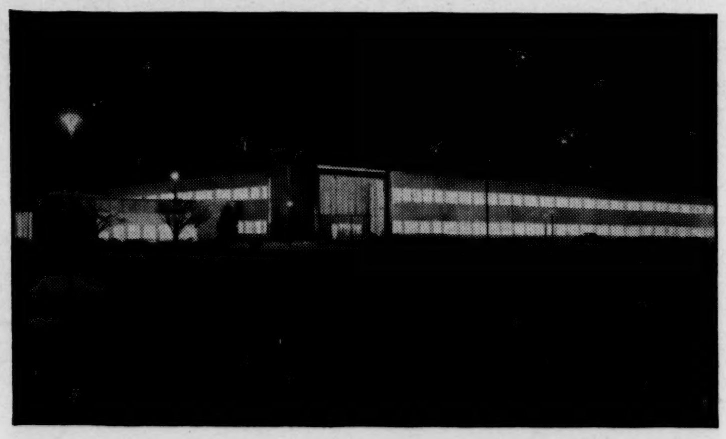

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RCA Develops Test Module Family

By George Alexander

New York—Building-block family of interchangeable test equipment modules, which can be added or subtracted to form complex or simple systems, has been developed to handle 84% of all standardized tests on electronic units, ranging from components to complete assemblies.

The modules—called the DEE (Digital Evaluation Equipment) family—were developed by Radio Corp. of America, Camden, N. J., as an outgrowth of an Army contract in 1959 for a test and checkout system capable of monitoring the electronic assemblies of Nike Ajax, Nike Hercules, Lacrosse, Sergeant and Hawk missile systems.

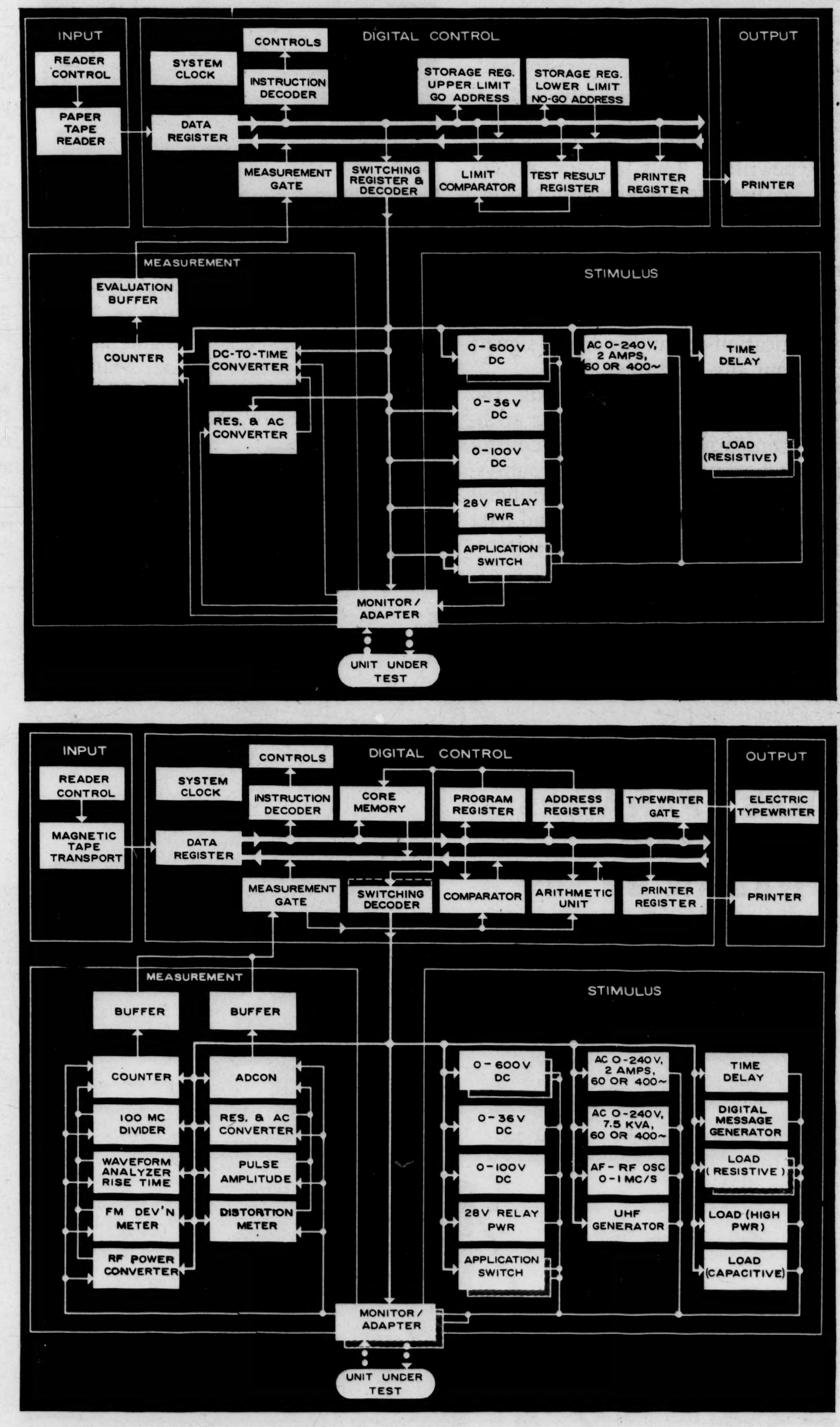
Now informally called "Grandfather DEE" by RCA engineers, this was a bulky fixed-installation system, consisting of 10 racks of equipment. Army then asked RCA in 1960 to develop a follow-on system with the same multipurpose test capability, but smaller in volume, lighter in weight and operable from a 2½-ton truck.

Computer-controlled DEE was RCA's solution and the other, simpler systems evolved from this.

Four Configurations

RCA is presently offering Digital Evaluation Equipment in four basic configurations, which can be tailored to fit individual requirements:

- **Programed Semi-Automatic.** Designed to be mated with the user's present test result printer, stimulus and measurement equipment, this simplified and basic DEE operates from a low-speed pre-programed paper or Mylar tape. System consists of a tape reader, control and display panel and monitor-adapter for units under test. Control circuitry has a data register, decimal-to-binary coded decimal encoder and switching. Test results are printed out and visually compared with standards by operator. Application of this system, contained in one rack, would be production line testing of electronic components or component grading and selection.
- **Programed Automatic.** Operating from high-speed pre-programed tapes, this system can store 300 test routines (equal to 13 diagnostic routines or 88 acceptance tests) on one 10-in. tape reel. Like all DEE systems, selection of monitoring points and measurement functions are automatically and remotely controlled. Measured values are compared with upper and lower test limits and each value is printed out with a HI, GO or LOW symbol keyed to a test number. Out-of-limit reading will stop the test routine and automatically kick in a fault isolation diagnosis subroutine (also on tape) to locate and identify the trouble. System, in 1½ racks, is designed for acceptance and diagnostic testing.
- **High Speed Automatic.** This DEE uses general-purpose computer elements (serial adder, limit comparator, etc.) to control test routines, stimulus inputs and result processing. Paper tape reader or magnetic tape with buffer memory unit performs limit comparison, test program search and fault isolation. In


INPUT
READER CONTROL
PAPER TAPE READER
SYSTEM CLOCK
CONTROLS
INSTRUCTION DECODER
DIGITAL CONTROL
STORAGE REG. UPPER LIMIT GO ADDRESS
STORAGE REG. LOWER LIMIT NO-GO ADDRESS
OUTPUT
DATA REGISTER
MEASUREMENT GATE
SWITCHING REGISTER & DECODER
LIMIT COMPARATOR
TEST RESULT REGISTER
PRINTER REGISTER
PRINTER
MEASUREMENT
EVALUATION BUFFER
STIMULUS
COUNTER
DC-TO-TIME CONVERTER
0-600V DC
AC 0-240V, 2 AMPS, 60 OR 400~
TIME DELAY
RES. & AC CONVERTER
0-36V DC
0-100V DC
LOAD (RESISTIVE)
28V RELAY PWR
APPLICATION SWITCH
MONITOR/ADAPTER
UNIT UNDER TEST
INPUT
READER CONTROL
MAGNETIC TAPE TRANSPORT
CONTROLS
DIGITAL CONTROL
SYSTEM CLOCK
INSTRUCTION DECODER
CORE MEMORY
PROGRAM REGISTER
ADDRESS REGISTER
TYPEWRITER GATE
OUTPUT
ELECTRIC TYPEWRITER
DATA REGISTER
MEASUREMENT GATE
SWITCHING DECODER
COMPARATOR
ARITHMETIC UNIT
PRINTER REGISTER
PRINTER
MEASUREMENT
BUFFER
BUFFER
STIMULUS
COUNTER
ADCON
0-600V DC
AC 0-240V, 2 AMPS, 60 OR 400~
TIME DELAY
100 MC DIVIDER
RES. & AC CONVERTER
0-36V DC
AC 0-240V, 7.5 KVA, 60 OR 400~
DIGITAL MESSAGE GENERATOR
WAVEFORM ANALYZER RISE TIME
PULSE AMPLITUDE
0-100V DC
AF-RF OSC 0-1 MC/S
LOAD (RESISTIVE)
FM DEV'N METER
DISTORTION METER
28V RELAY PWR
UHF GENERATOR
LOAD (HIGH PWR)
RF POWER CONVERTER
APPLICATION SWITCH
LOAD (CAPACITIVE)
MONITOR/ADAPTER
UNIT UNDER TEST

PROGRAMED AUTOMATIC DEE (top) and Computer Controlled DEE (bottom) reveal strong family resemblance, sharing many identical interchangeable modules. About 84% of all standard test routines run on electronic units can be performed with DEE modules; special modules (such as digital message generator) are needed only for particular tests.

addition to the analog stimuli, system includes a digital message generator for testing and checkout of digital devices (such as airborne computers). Application of this DEE, in two racks, would be on mass production and quality control lines, where repetitive high-speed testing is required.

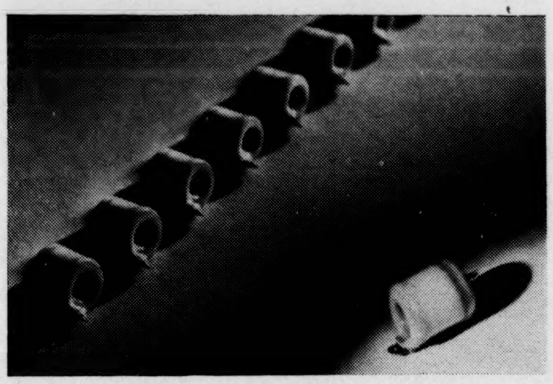
- **Computer Controlled.** Using some hardware and techniques of high-speed, large volume data processors, this system stores test instructions and programs on magnetic tape. Arithmetic computations are performed by an arithmetic unit from data stored in a high-speed aperture plate memory unit. A fast-response waveform analyzer is used instead of an oscilloscope and prints out measured values on an electric typewriter. This 3½-rack system could be used for production testing, field checkout, depot maintenance or research and development testing evaluation.

Key to the control unit in every DEE system is the "data bus"—a two-way communication circuit for digital signals throughout the controller.

In addition to interconnecting the data and instruction registers, the arithmetic, comparison, switching control and (when required) memory subsystems, the data bus also links peripheral equipment, such as typewriters and data printers, to the rest of the DEE system.

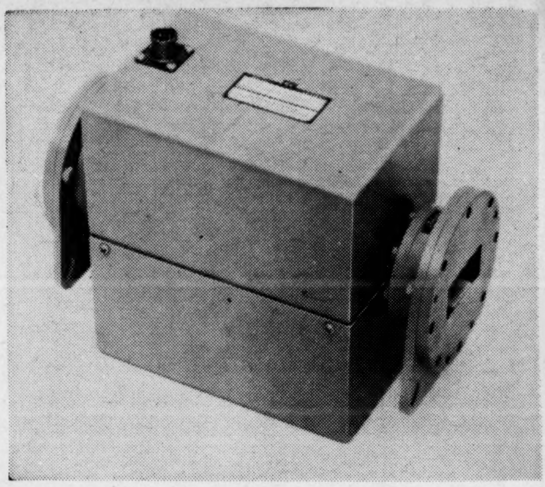
NEW AVIONIC PRODUCTS

- **Miniature triggered spark gap,** Type Z-5362, for switching single stored electrical energy into low-impedance load, such as multiple explosive bolts, can handle 18 joules of energy at 3,000 v., switching in 1.0 to 1.5 microseconds.



The brazed ceramic tube can withstand shock of several thousand g forces for several milliseconds and operates over temperature range of -80F to 200F. Device measures 0.7-in. diameter and 1.25-in. long, weighs 0.3 oz. Manufacturer: General Electric Co., Tube Dept., Schenectady, N. Y.

- **Variable phase shifter,** Model G332, can provide phase shift ranging from zero to more than 180 deg. over frequency range of 5,550 to 5,750 mc. with insertion loss of only 0.6 db. The phase shift is controlled by applied voltage which ranges from 0 to 25 v. At constant control voltage, phase shift setting is maintained within 5 deg., over temperature range of -20C to 65C. Power handling capability is 30 kw. peak and 30 w. average. Maximum VSWR is 1.30. Manufacturer: Cascade Research Div., Lewis & Kaufman Electronics Corp., 5245 San Fernando Rd., West Los Angeles.



- **Pneumatic reaction actuated gyro** (PRAG), Series 36, a miniature, low-cost gas-operated two-axis gyro, includes automatic recaging feature which permits repeated use without removing gyro from vehicle. Gyro will operate on either dry nitrogen or dry air, pro-

HUGHES "PARAMPS" EXTEND RANGE OF GCA RADAR BY 50%

Today Hughes will have delivered its 317th fully qualified S-Band parametric amplifier for modernization of the AN/CPN-4 (MNP-11) GCA radar system. These systems provide the USAF with an effective world-wide GCA radar network for safer guidance of jet aircraft.

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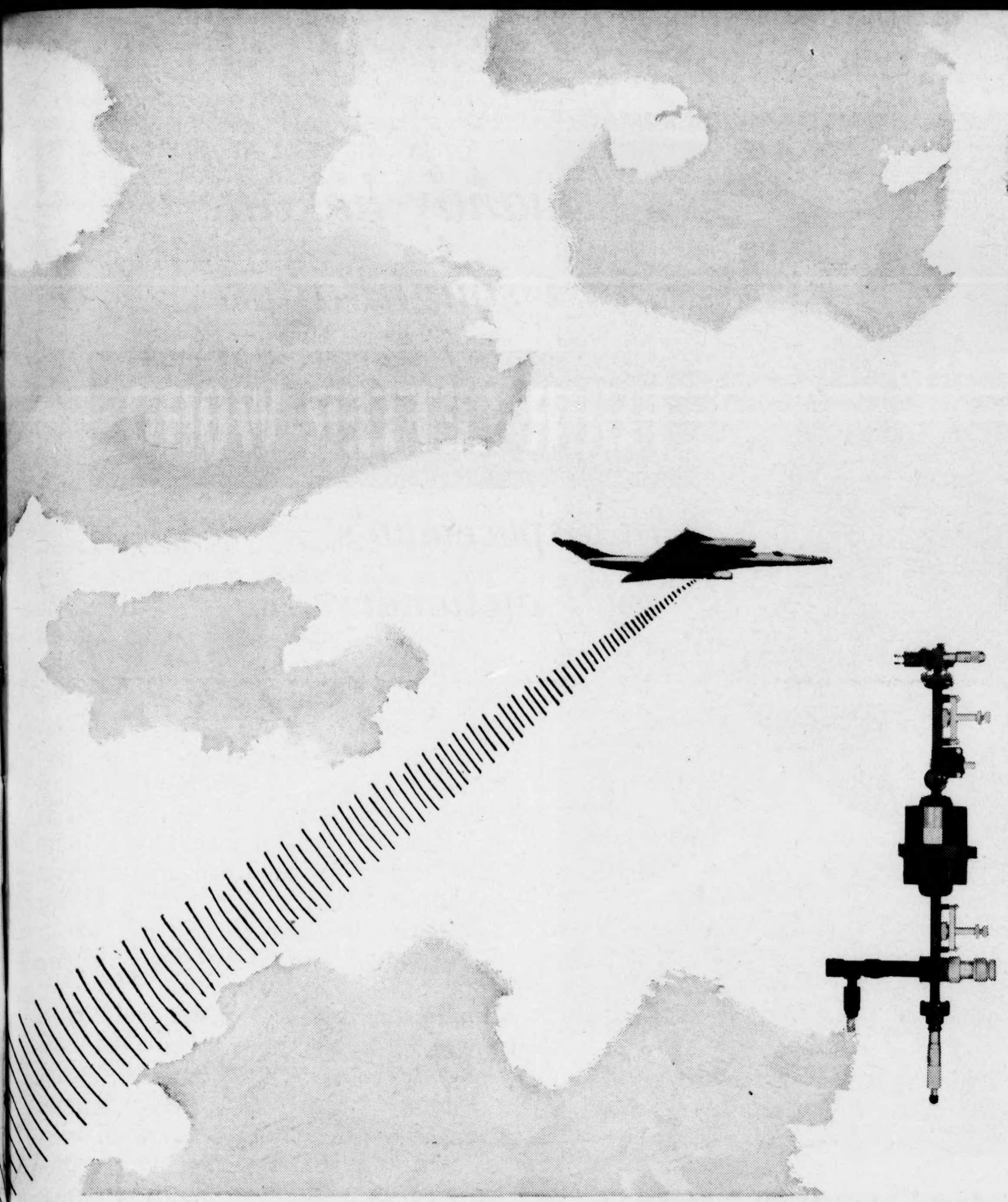

Hughes today is the only supplier of systems proven parametric amplifiers in production quantities. Hughes S-Band paramps have been operationally tested in these systems: AN/CPN-4 (MPN-11), SCR-584, MSQ-1A, AN/CPN-18, MPS-19, MPQ-31, Mod. 2 and APS-82.

Whatever your parametric amplifier needs—at L, S, C or X-Band—Hughes is most qualified to serve you.

For information, or to order the Hughes Model 1020-A Parametric Amplifier, contact: Hughes Components Division, Marketing Operations, Culver City, California. TWX HAC SMON 7396-U; Phone UPton 0-7111, Ext. 4190.

SPECIFICATIONS FOR S-BAND MODEL 1020-A PARAMETRIC AMPLIFIER

Frequency Range (Tunable)	Any 200 mc in 2 Kmc to 3 Kmc range
Bandwidth	20 - 30 mc
Gain (Minimum)	17 db
Single Channel Radar Noise Figure	2.5 db including circulator loss
Type of Operation	Non-degenerate
*Unit Price	$7,590 (less in quantity)
Delivery	90 days after receipt of order

*Price quoted above includes basic amplifier body, varactor diode, circulator and klystron. Pump power supply also available if desired. Specifications, price and delivery subject to change without notice.

HUGHES

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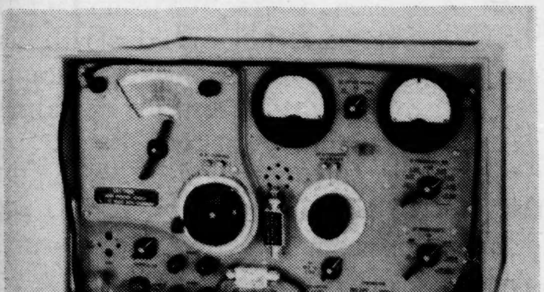
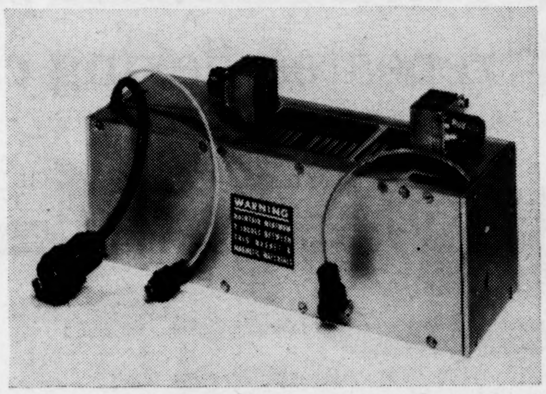
vides low-drift attitude reference for four minutes of continuous operation, or up to 6 min. with some loss of accuracy. Gyro weighs less than 3 lb., measures 3⅜ in. dia. by 4½ in. long. Standard units come with potentiometer pick-offs, but other types are available. Manufacturer: Sanders Associates, Inc. Instruments Div., Nashua, N. H.

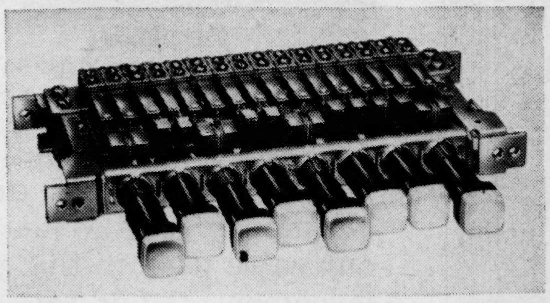


• **Flexible signal generator,** Model 12/U, provides FM and unmodulated RF signals. One of two output cables supplies output voltages at nine different crystal controlled frequencies corresponding to widely used intermediate frequencies. The other cable supplies RF output signals in frequency range of 20 to 100 mc. in five bands. IF output is variable, 0.5 microvolt-1 v., RF output, 0.05-10,000 microvolts. Manufacturer: Systems, Inc., 2400 Diversified Way, Orlando, Fla.

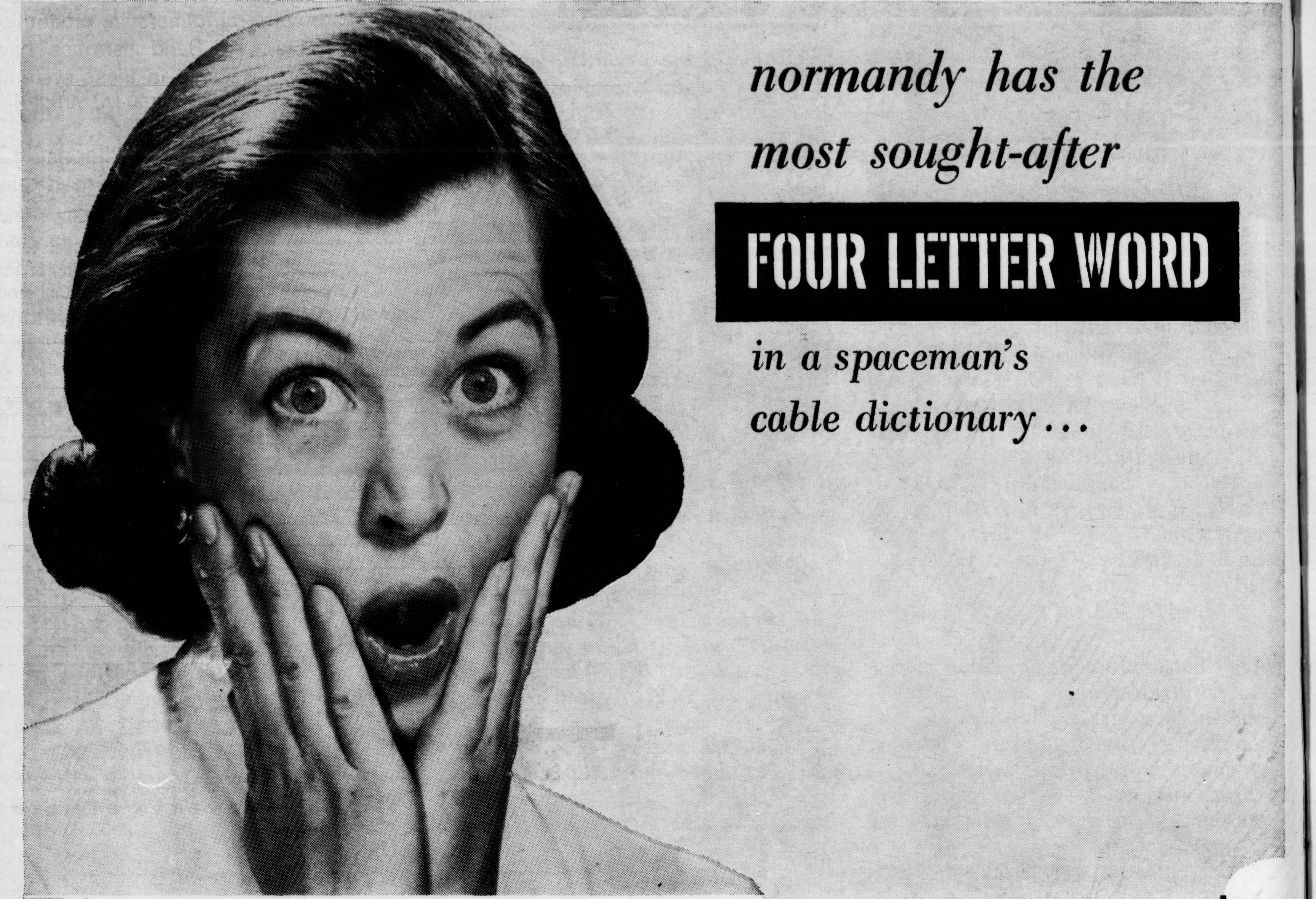


• **Low-noise traveling wave tube,** Type Z-3103, for use in the 7 to 11 kmc. frequency range, is designed to withstand 50g shock and 5g vibration. The metal-ceramic tube has noise figure less than 10 db., minimum gain of 25 db. and power output of 5 mw. across the band, according to manufacturer. Tube is supplied as complete package, including permanent focusing magnets. Weight is 11½ lb. Price is $2,850. General Electric Co., Power Tube Dept., Palo Alto.

• **Digital buffer storage unit,** Model 1520, provides isolation and storage between variety of digital measuring instruments and associated printers, punches or other readout devices. Device accepts either decimal or binary coded decimal information in the form of voltage states or contact closures and provides isolated decimal contact closure outputs. Data input transfer time is as low as 100 microseconds and output contact closures remain fixed until reset or recycled. Model 1520 has storage capacity of 8 decimal digits and is fully transistorized. Manufacturer: Auto Data, P. O. Box 9146, San Diego.



• **Illuminated multi-switch,** Series 21000, is available with up to 37 stations, and in three different operating voltages; 6 v.d.c., 28 v.d.c. and 115 v.a.c. Several rows of switches can be ganged together and provided with interlock action between all buttons. More than one station switch can be depressed at a time or lock-out bar can be provided to prevent depressing more than a single switch. Manufacturer: Switchcraft Inc., 5555 N. Elston Ave., Chicago 30.



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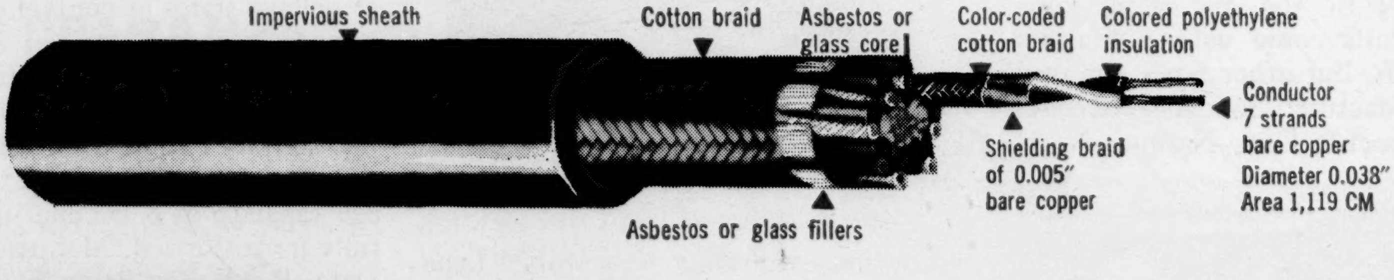
TYPE **TTRS** twisted-shielded-pair, radio, repeated flexing cable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Asbestos or glass core
Color-coded cotton braid
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Shielding braid of 0.005" bare copper
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FINANCIAL

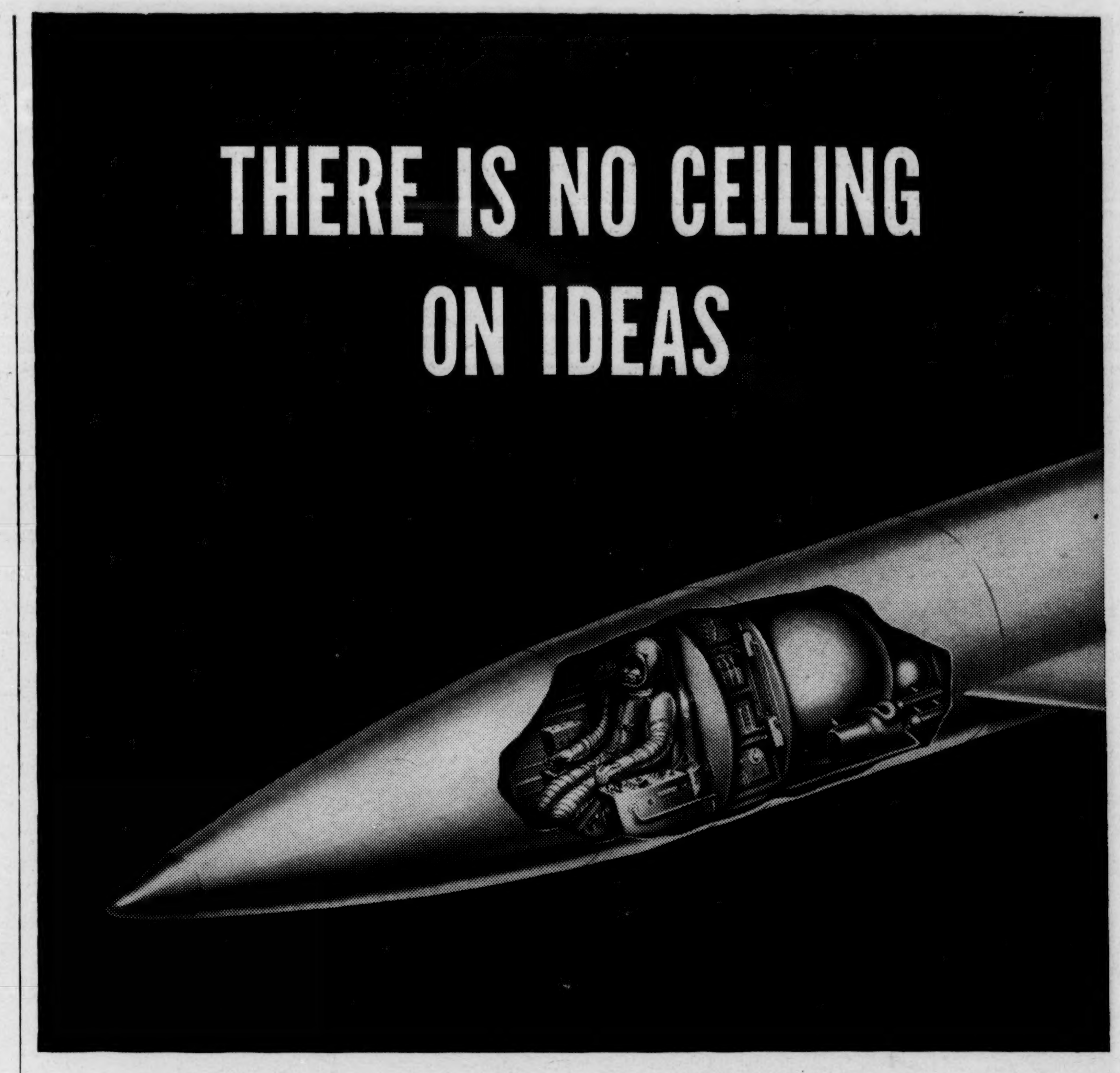
New Offerings

Wings and Wheels Express, Inc., Flushing, N. Y., engaged principally in the business of freight-forwarding by air; the company also provides "terminal handling" service at Chicago. Offering is 85,000 shares of common stock, for public sale at $3 per share on an all-or-none basis; offering also includes 10,000 shares of common stock and 34,000 five-year warrants to purchase a like amount of common shares at ascending rates of from $3 to $5 per share, which were sold to the underwriters and others for an aggregate of $33,400. Of the proceeds, $94,400 will be used for the expansion of the company's existing services; enlargement of its sales force in the present 42 geographical areas of service; expansion and modernization of facilities for handling air freight shipments; balance will be added to working capital to finance accounts receivable and for general corporate purposes.

Wollard Aircraft Service Equipment, Inc., Miami, Fla., engaged in the manufacture and sale of a wide variety of ground, field and hangar equipment used to service commercial and military aircraft. Offering was 135,000 shares of common stock for public sale at $4 per share. Of the estimated net proceeds, $260,000 will be used for a proposed new plant; $58,500 for new machinery; $8,000 for moving expenses; balance will be added to the general funds as working capital.

Consolidated Airborne Systems, Inc., New Hyde Park, N. Y., engaged primarily in the design, development and production of proprietary devices in the field of electronic and cryogenic ground support equipment and airborne instrumentation for the military and commercial aircraft industry. Offering is 180,000 shares of Class A stock for public sale; offering price and underwriting terms to be supplied by amendment. Of the proceeds, $112,500 will be used for the repayment of notes owing to certain former and present officers, directors and Class B stockholders (the proceeds of which notes were used for working capital); to repay bank loans of $100,000; for research and development and expansion of manufacturing facilities and for working capital.

Vacuum-Electronics Corp., Plainview, N. Y., engaged in designing and producing various kinds of high vacuum and related leak detector systems, and also sells various components and accessories for such systems. Offering is 100,000 shares of common stock for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- **Aircraft Flight and Electronic Systems—Largest supplier of airborne centralized flight data systems; also working with other electronic controls and instruments including missile and submarine applications.**
- **Missile Systems—Largest supplier of accessory power units, AiResearch is also working with hydraulic, hot gas and hydrogen systems for missiles, liquid and gas cryogenic valves and controls for ground support.**
- **Gas Turbine Engines—World's largest producer of small gas turbine engines, with more than 9000 delivered in the 30—850 hp class. Studies include industrial and nuclear applications.**

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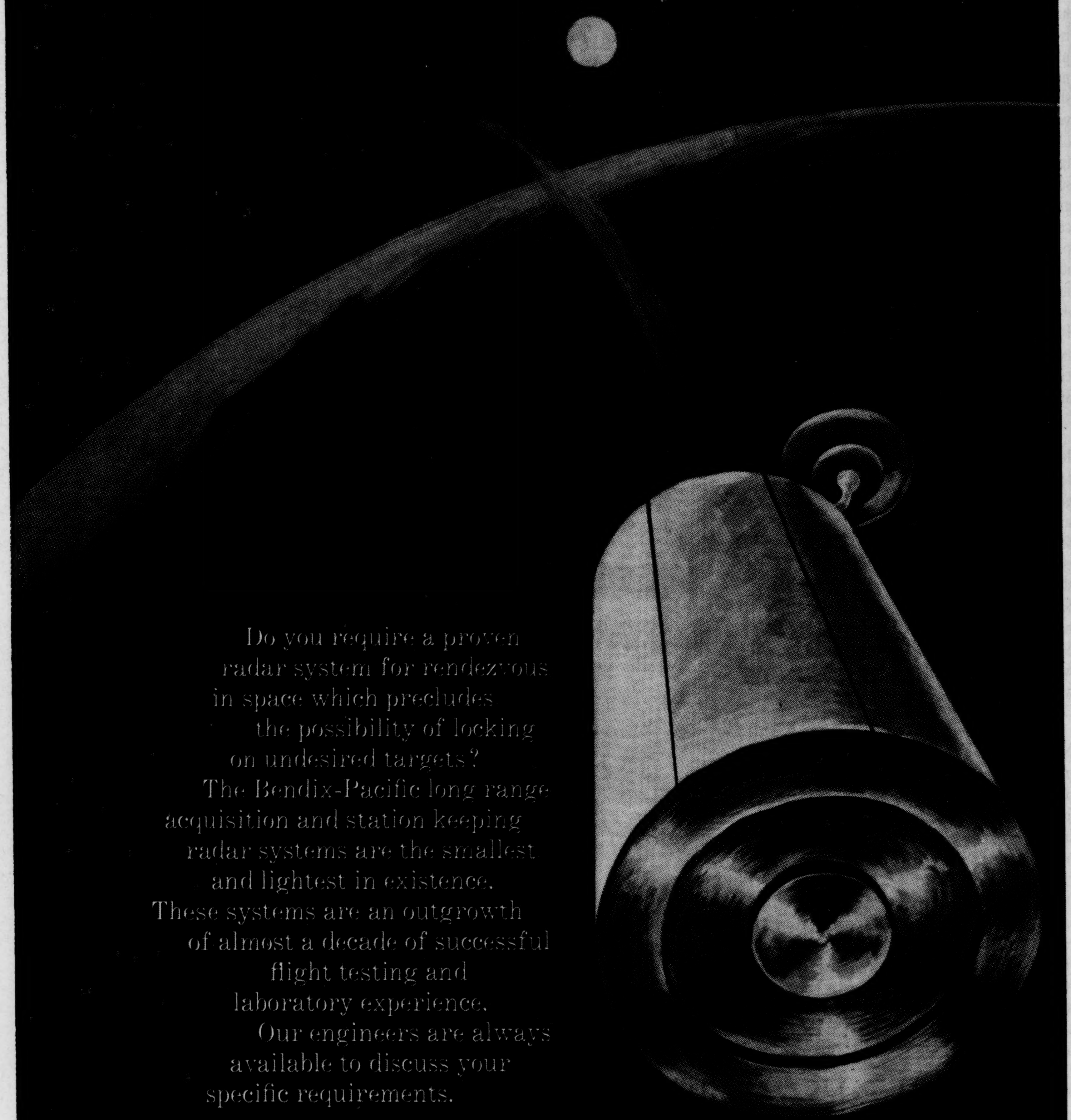

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public sale; offering price and underwriting terms to be supplied by amendment. Of the proceeds, $1,100,000 will be used to retire outstanding loans incurred in connection with the acquisition of land in Plainview and construction of plant and offices; balance will be added to working capital and used for general corporate purposes.

Digitronics Corp., Albertson, N. Y., principally engaged in the design, manufacture, sale or lease, installation and maintenance of electronic digital systems, and the design, manufacture and sale of electronic components for data handling and file processing. Offering is 50,000 shares of capital stock for public sale; offering price and underwriting terms to be supplied by amendment. Up to 20,000 of such shares may be sold by the underwriters to one or more purchasers designated by the company at the public offering price, less an underwriting discount. Offering also includes 84,050 outstanding shares, which are part of 150,000 shares which had previously been owned by the four organizers of the company and which were acquired by certain investors in Sept. 1959, and may be offered for sale from time to time in the future.

Of the proceeds, $200,000 will be used to retire short-term bank loans; balance will be added to general funds to be used toward financing new product development and the cost of equipment available for lease to customers, and for additional working capital.

Rixon Electronics, Inc., Silver Spring, Md., a custom electronics engineering and development company engaged in the development and production of specialized electronic equipment for use in modern communications, instrumentations, data processing and other electronic systems. Offering is 115,000 shares of capital stock for public sale; offering price and underwriting terms to be supplied by amendment. Proceeds will be used to pay existing bank indebtedness of $162,522 and existing demand notes to James L. Hollis, president, of $45,000; the balance to be added to working capital for use in connection with the company's expansion plans. It is expected that $100,000 will be applied to further research and development relating to proprietary products; $30,000 to finance expansion of the marketing program; $50,000 applied to the purchase of shop, technical and other capital equipment needed in connection with the proposed new plant facilities; the balance to strengthen the company's financial position to permit it to accept new orders in connection with the expanded production and exploitation of certain proprietary products.

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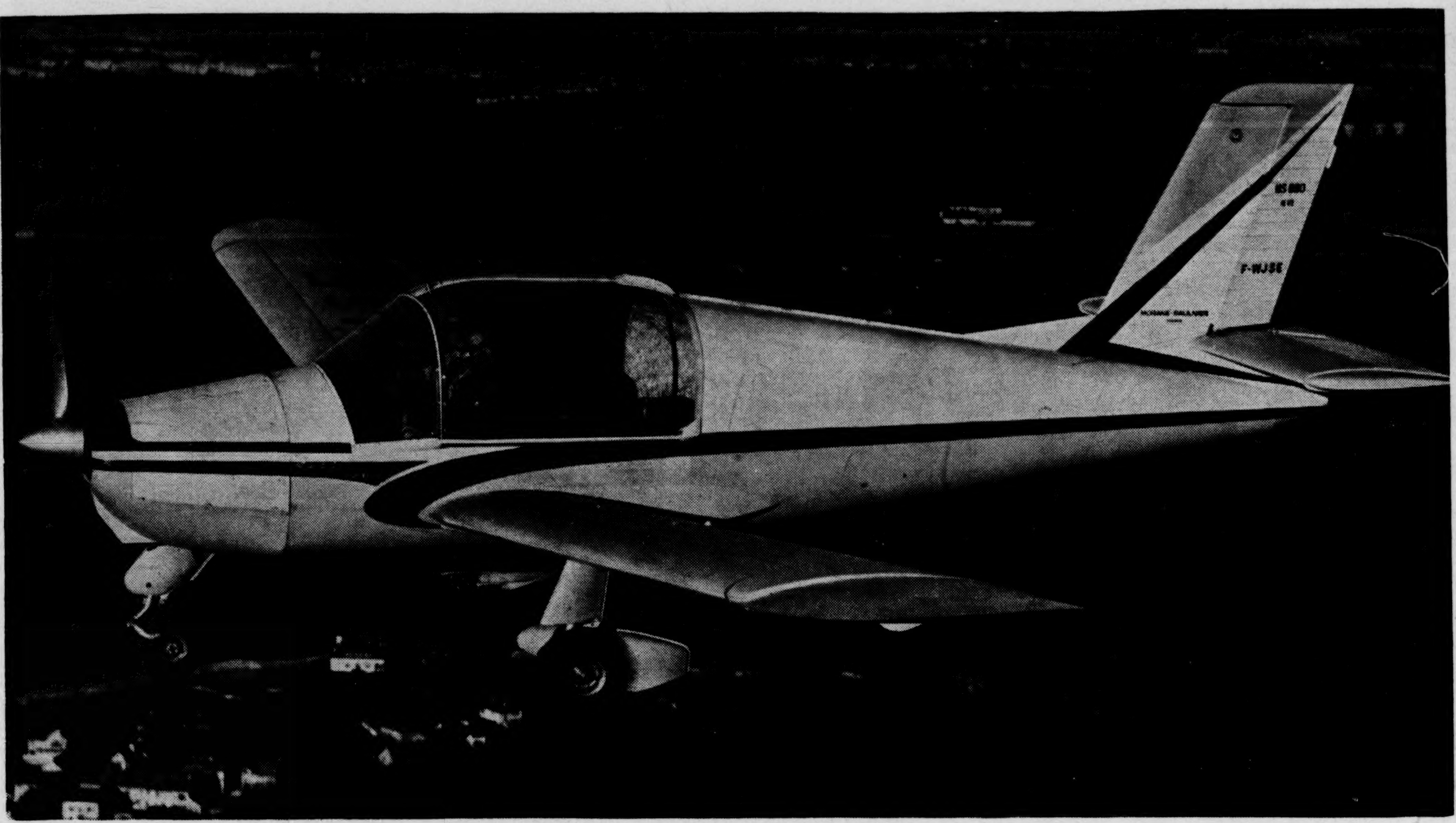


SECOND prototype of Morane-Saulnier MS-880 Rallye is shown on its first flight Feb. 10. Plane is powered by a 100-hp. Continental engine. The No. 3 airplane will be sent to the U. S. for demonstration purposes. Marked change for first Rallye is its sweptback tail.

French Rallye to Be Assembled in the U.S.

By Herbert J. Coleman

Morane-Saulnier Rallye single-engine lightplane will be assembled in the U. S. this year in a determined bid by the French manufacturer to capture a share of the American business plane market.

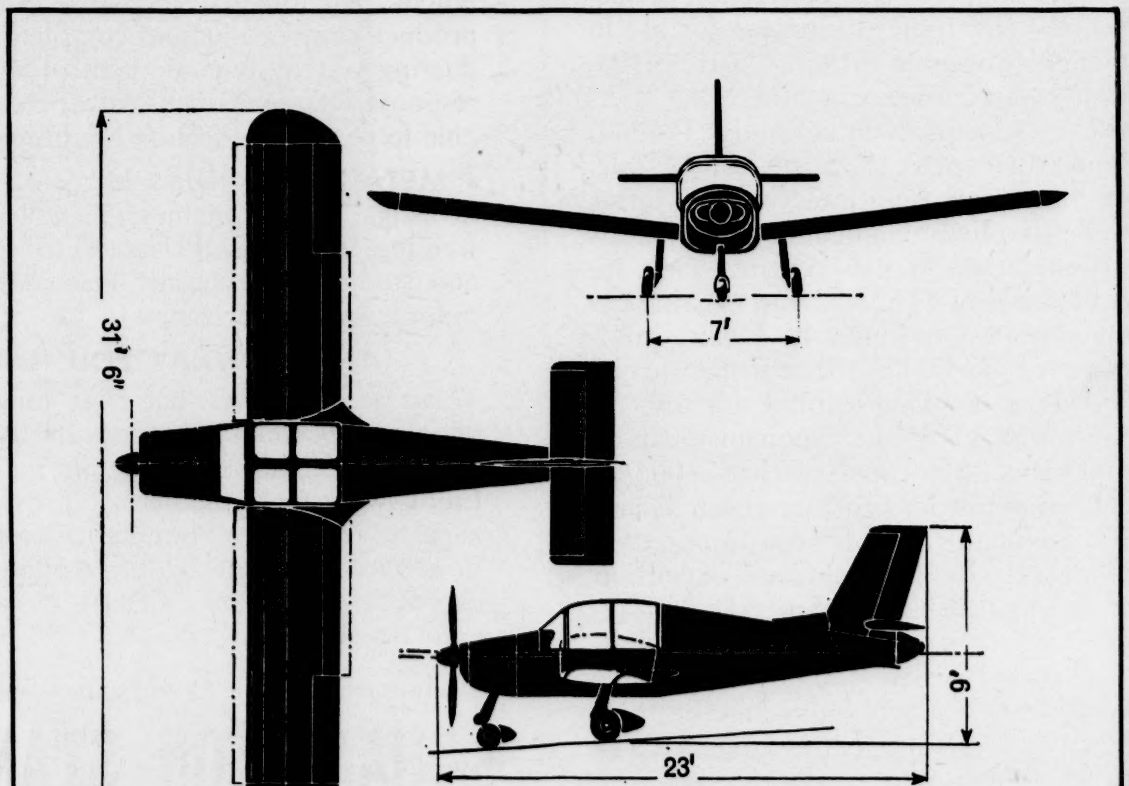
The airplane has already developed a marked interest in European markets (AW Sept. 1, p. 92). Last month, Morane-Saulnier had 166 firm orders, of which 85 came from 17 foreign countries. Plane is offered in three versions:

- **Rallye 880,** powered by a Continental C-90-14F 90-hp. engine. The U. S. price is $5,750.
- **Super Rallye 880,** powered by a Continental D-200-A 100-hp. engine, priced at $5,995.
- **Rallye 885,** powered by Continental C-320-A engine delivering 145 hp. Price will be $7,995.

Morane-Saulnier has completed a license agreement with Coleton Aircraft Corp., Muskegon, Mich., a new company headed by P. M. Coleman, Glencoe, Ill., who also is president of Midwest Aircraft Sales and managing director of the Trans-Atlantic Division of Keegan Aviation, Ltd.–British-based ferrying company.

Coleman said Coleton Aircraft will assemble the Rallye at a newly acquired production site at Muskegon Airport. Engines will be delivered on the spot by Continental Motors Corp., which builds them at Muskegon. All major airframe components will be built in France and air-freighted to Muskegon for assembly and engineering test flights.

By the end of this year, Coleton Aircraft plans to have at least one Rallye in every state, for sales and



RALLYE carries 26 gal. of fuel and has a gross weight of 1,708 lb.

demonstration purposes. Company now is setting up dealerships. Under present projections, Coleman said, the firm will assemble up to 50 Rallyes a month in 1962.

First U. S. Rallye will be the No. 3 prototype, MS 885. The airplane will be delivered to Muskegon on Apr. 1 and later will participate in a national demonstration tour.

The original prototype has flown more than 1,000 hr. in various operating regimes, ranging from Scandinavian mountain flying to African jungles. By next July, Morane-Saulnier plans a production run of 30 Rallyes a month—a lightplane production rate never before undertaken in France.

The second prototype differs from the first (AW June 20, p. 272) through the addition of a swept tail, an extruded canopy and a larger cabin for three-place seating. Landing gear also has been faired over and control sticks have been replaced by wheels.

The airplane, designated Coleton Rallye for U. S. sales, now is undergoing Federal Aviation Agency and French government certification in France. Plane has been designed to Civil Air Regulation Part 3 requirements. All models will be licensed in "utility" category at full gross weight, and "aerobatic" with two persons aboard.

Coleman said the airplane features automatic wing slots to increase slow-flight capabilities. McCauley all-metal propeller is standard equipment, as are toe-brakes and primary instrument panel. Also standard is automatic carburetor heat, activated when engine is at idle speed.

Coleton Aircraft Corp. eventually plans to handle distribution of the Morane-Saulnier Paris 761, a higher-powered version of the MS 760 twin turbojet (AW May 15, p. 35). Beech Aircraft has canceled plans to sell the jet, but still has the demonstrator. New version will be powered by a 1,000-shp. Marbore turbine and currently is undergoing certification tests.

Future design plans call for development of a seven-passenger version of the 760/761 jet series, according to Coleman. He said Morane-Saulnier also is considering a twin-engine version of the 880/885 Rallye series.

The Rallye and Super Rallye both carry 26 gal. of fuel and have gross weights of 1,708 lb. The MS-885 carries 44 gal. of fuel and gross weight is 2,200 lb. Plane lands at 43-46 mph. and maximum true airspeed (standard conditions, sea level) ranges from 121 mph. for the Rallye 880, 128 mph. for the Super Rallye and 143 mph. for the Rallye 885. Cruise speeds (standard conditions at 2,625 ft.) range from 106 mph. for the 90-hp. version to 130 mph. for the 145-hp. model.

Length is 23 ft. and wingspan is 31 ft. 6 in., with a wing area of 132.5 sq. ft. Rallye is 9 ft. high (tail to ground) and main gear spacing is 7 ft. The aspect ratio is 7.57 and cabin width is 4 ft.

Coleman said facilities will be added to the 50,000 sq. ft. of production plant space for servicing. Scot-Air Division has been formed to distribute Coleton products in the Muskegon area, and to provide facilities for pilot training and refueling. Parts depot will be opened later.

Associated with Coleman in Coleton Aircraft are W. J. Snelten, Deerfield, Ill., vice president, owner of Salon Photo, Inc., Glencoe, a photo-finishing laboratory; K. C. Davies, River Forest, Ill., secretary, formerly associated with Lake States Imports, Renault distributors, and M. H. Coleman, treasurer, president of Conveyor Systems, Inc., Morton Grove, Ill.

Howard to Head Army Technical Committee

National Aeronautical Services Assn., Washington, D. C., has named Beverly E. (Bevo) Howard chairman of a Technical Committee on Army Aviation. Howard is president of Hawthorne School of Aeronautics, which conducts Army flight training at Ft. Rucker, Ala.

Other members are M. Ramsey Horton, director of materiel, Southern Airways Co. (helicopter school), Camp Wolters, Tex.; Rex H. Madeira, executive vice president, Page Aircraft Maintenance, Inc., Ft. Sill, Okla.; and W. T. Neal, general manager, Ft. Rucker Division, the Hayes Corp., Ft. Rucker.

Committee will meet during the association's annual meeting Apr. 13-14 in Washington. It was formed at the suggestion of Maj. Gen. Richard D. Meyer, Army deputy chief of transportation (aviation) to offer technical assistance in studying specific Army aircraft maintenance problems.

PRIVATE LINES

Cessna Model 185 Skywagon has received its Federal Aviation Agency aircraft type certificate.

Piper Aircraft Corp. shipped more than $6-million worth of its line of business planes to overseas dealers last year. Actual billing was $6,045,678, against $2,902,996 the year before. Most twin-engine planes were flown to their destinations. Total of 58 countries received Piper airplanes.

James C. Buckley, Inc., industrial and transportation consultants at 30 East 40th St., New York City, has estab-

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The Applied Physics Laboratory of the Johns Hopkins University has an unusually attractive career position available.

The man selected will serve as liaison and instrumentation engineer between the Laboratory and manufacturers and government offices. He will monitor launchings of satellites and missiles at Cape Canaveral and other test sites as an APL representative and will also act in a technical advisory capacity. Closely supervised at the outset, he will soon enjoy a high degree of independence. He will spend one-third of his time on trips of three or four days duration.

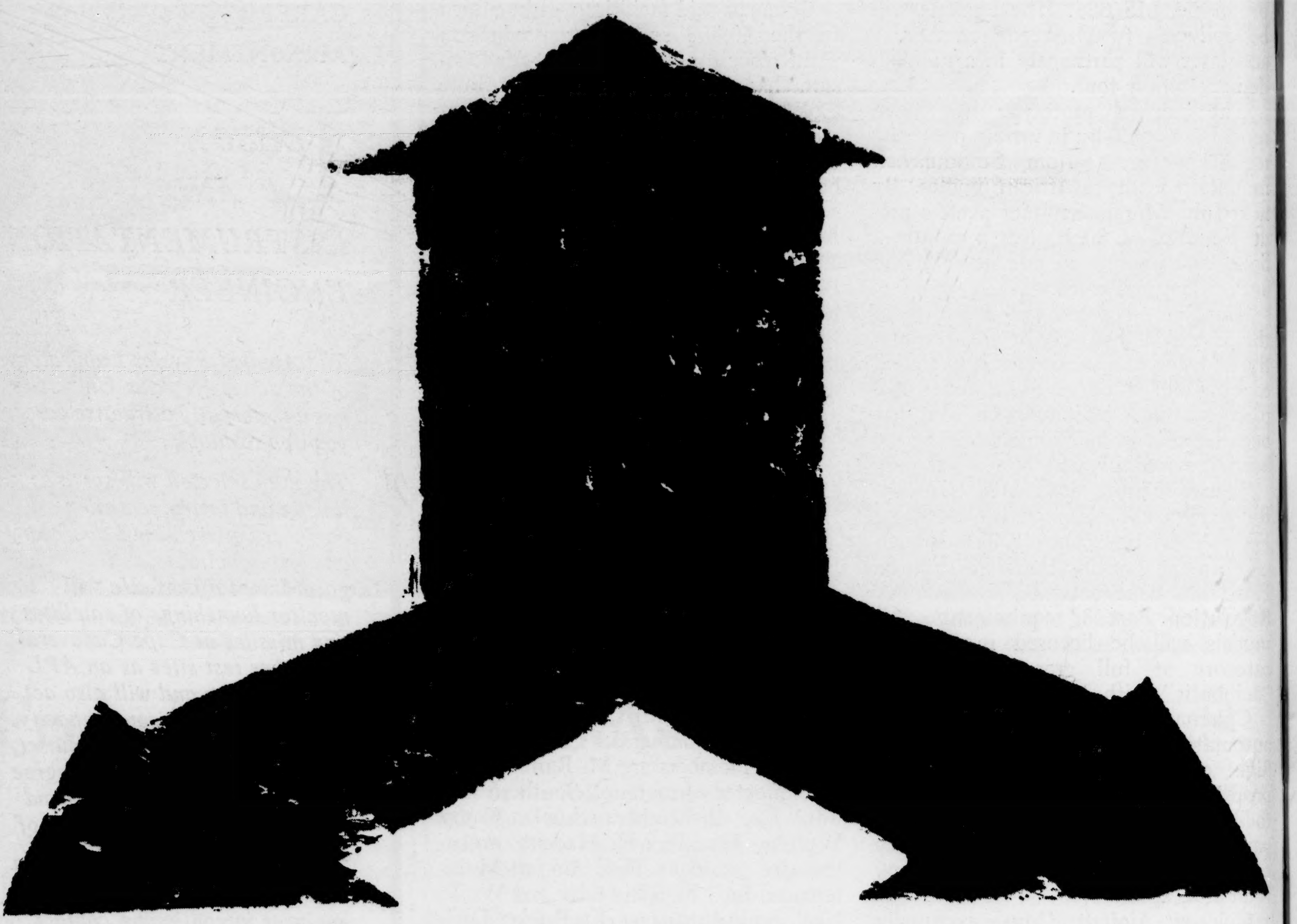
The duties will place this engineer in continuing contact with high-level personnel in numerous fields. The position offers an uncommon opportunity to gain an extremely broad understanding of the entire space-missile spectrum.

Qualifications for this appointment include a degree in engineering plus three years of experience in missile instrumentation, ground instruments, playback equipment, and data reduction. Some knowledge of computers is desirable.

**For additional details about this position, direct your inquiry to:
Professional Staff Appointments**

The Applied Physics Laboratory
The Johns Hopkins University

**8667 Georgia Avenue, Silver Spring, Md.
(Suburb of Washington, D.C.)**



Said Hans Oersted: *"When a conductor carries current through a magnetic field at right angles to it, the resultant reaction thrusts the conductor in a direction perpendicular to both the current and the magnetic field."*

A light-weight, low fuel-consuming propulsion system is a primary requirement for interplanetary space vehicle travel. One such system now being carefully studied utilizes plasma propulsion.

This concept employs an electrical field to produce a plasma and to energize it. A magnetic field then ejects the plasma, thereby providing a reactive thrust to the vehicle.

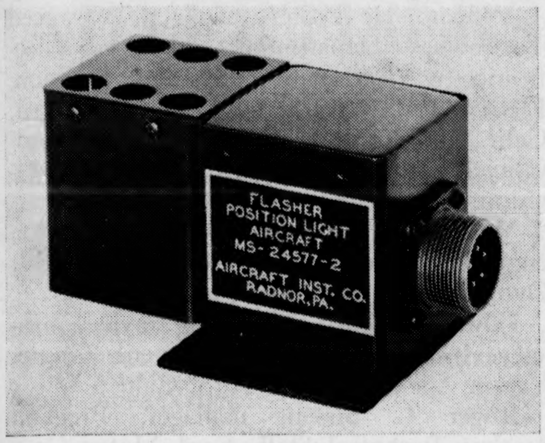
Plasma propulsion is but one of many subjects under investigation at Lockheed Missiles and Space Division. Outstanding facilities, equipment and scientific personnel mark the organization as eminently capable of exploring many unusual aspects of space travel. This, coupled with Lockheed's favorable locations in Sunnyvale and Palo Alto on the beautiful San Francisco Peninsula, consistently attracts scientists and engineers interested in pursuing work in their special fields.

Why not investigate future possibilities at Lockheed? Write Research and Development Staff, Dept. M-26A, 962 West El Camino Real, Sunnyvale, Calif. U.S. citizenship or existing Department of Defense industrial security clearance required.

Lockheed / MISSILES AND SPACE DIVISION

Systems Manager for the Navy POLARIS FBM and the Air Force AGENA Satellite in the DISCOVERER and MIDAS Programs

SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA • CAPE CANAVERAL, FLORIDA • HAWAII



Position Light Flasher

Position light flasher, solid-state type with no moving parts, can supply 1 to 5 amp. at 28 v.d.c., flashed off and on at rate of 85 per minute, ±5 cycles. Device weighs 0.9 lb. and meets MIL-I-26600 specification on Radio Interference, according to manufacturer: Aircraft Instruments Co., Radnor, Pa.

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lished a special section to provide technical analysis for companies operating or interested in operating business aircraft. Areas covered, under direction of John C. Lambert, are equipment evaluation, fleet management, base locations and cost analysis.

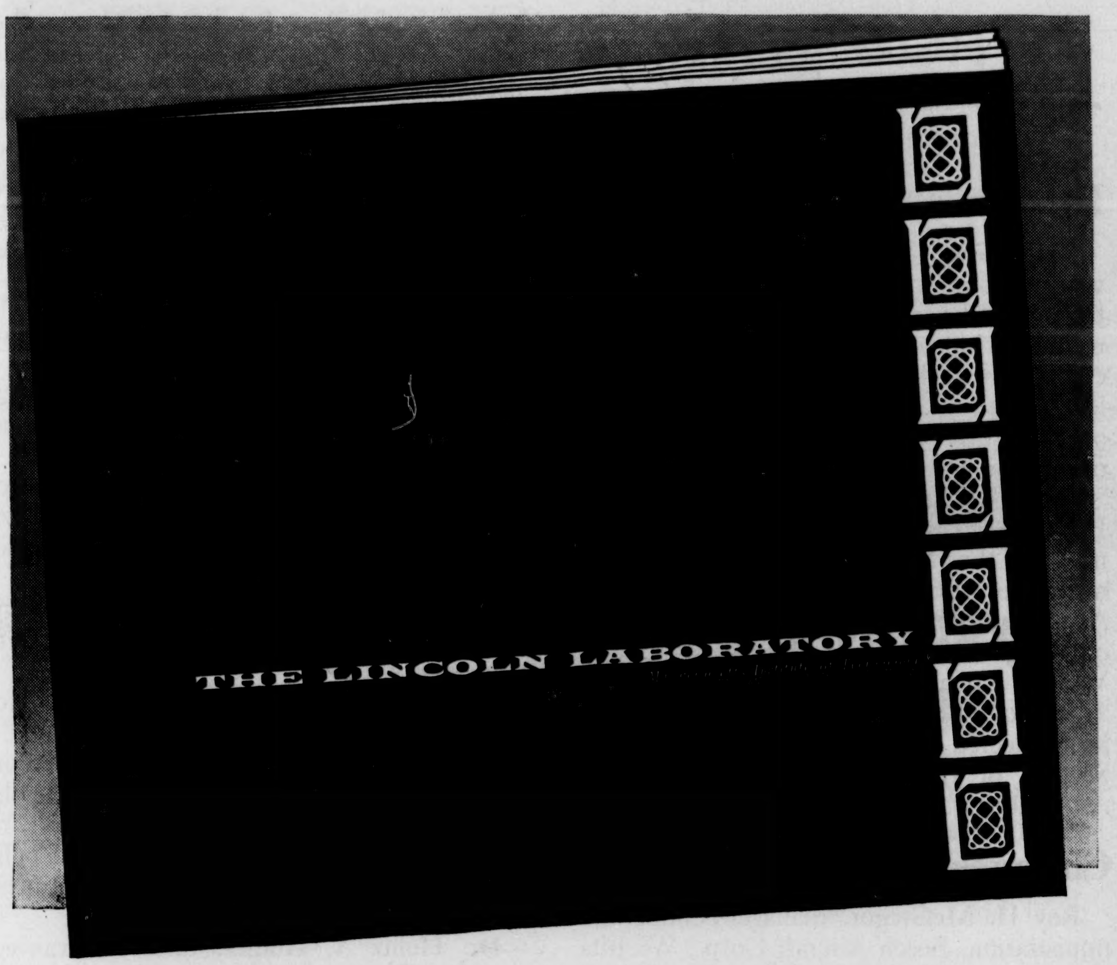
Spartan Air Services, Ltd., Toronto, Can., has signed a contract for $485,000 for air survey and mapping work in the province of San Luis, Argentina. Arrangement was made by Spartan's newly formed Argentinian subsidiary, Buenos Aires.

Flightcraft, Inc., Portland, Ore., has purchased Oregon Air-Motive, also of Portland, an FAA-approved instrument and autopilot repair shop. Company will be operated as a Flightcraft Division, with founder C. E. Perrott as shop manager.

Lake Aircraft Corp., builder of the Lake LA-4 Amphibian, has sent one of its planes on a 20,000-mi. demonstration tour of South American countries. Pilot is Calvin Tompson. Francisco Labarta of Air Carrier Service Corp., Washington, D. C., will handle sales in 73 cities visited.

Cessna Aircraft is shipping 37 single-engine business planes by boat from New Orleans, La., to Rex Aviation Pty., Ltd., at Bankstown, NSW, Australia. Shipment to its Australian distributor is worth more than $500,000.

New helicopter charter service, Dukkopters Sales & Service, Inc., has been established at Miami, Fla., utilizing a Hiller 12E and 12C. Company, headed by Willis H. duPont, also operates duPont Airways, a fixed-wing charter service.



The Lincoln Laboratory, Massachusetts Institute of Technology, announces a major expansion in its program. We urgently request the participation of senior members of the scientific community in our programs in:

- RADIO PHYSICS and ASTRONOMY
- SYSTEMS:
  - Space Surveillance
  - Strategic Communications
  - Integrated Data Networks
- NEW RADAR TECHNIQUES
- SYSTEM ANALYSIS
- COMMUNICATIONS:
  - Techniques
  - Psychology
  - Theory
- INFORMATION PROCESSING
- SOLID STATE Physics, Chemistry, and Metallurgy

- A more complete description of the Laboratory's work will be sent to you upon request.

Research and Development
LINCOLN LABORATORY
Massachusetts Institute of Technology
BOX 29
LEXINGTON 73, MASSACHUSETTS

WHO'S WHERE

(*Continued from page 19*)

Honors and Elections

Maj. Gen. Albert Boyd (USAF, ret.), vice president and general manager of Westinghouse Electric Corp.'s Defense Products Division, has been awarded the company's Order of Merit for "vision and leadership which have inspired throughout Westinghouse a better understanding of defense and space problems. . ."

Frank L. Dobbins, director of materiel for Boeing Airplane Co., has been elected chairman of the Materiels Procurement Committee for 1961 of the Aerospace Industries Assn., and **W. R. Kiefer,** materials manager of Vought Aeronautics Division of Chance Vought Corp., was elected vice chairman.

Stanford Professor **Howard S. Seifert** has been elected to the Engineering Sciences Section of the International Academy of Astronautics.

Changes

Roy H. McGregor, manager-contract administration, Beech Aircraft Corp., Wichita, Kan. Other Beech appointments: **Ed C. Nikkel,** weapon system manager for the B-70 alert pod program; **George R. Selig,** executive project administrator-all military projects; **T. L. Maltby,** weapon system manager for the XKD2B-1/Q-12 missile target system.

Roy E. Wendell, public relations director, Hamilton Standard Division of United Aircraft Corp., Windsor Locks, Conn., succeeding **E. Russell Trotman,** who has been transferred to United Aircraft.

James E. Dow, chief, Air Traffic Control and Navigation Branch, Systems Engineering Division, Federal Aviation Agency's Bureau of Research and Development.

Rear Adm. Henry C. Bruton (USN, ret.), director, Fleet Communications Division, Alpha Corp., Dallas, Tex. a subsidiary of Collins Radio Co.

William T. Immenschuh, chief engineer, Ryan Aeronautical Co.'s Aerospace Division, San Diego, Calif.

Dr. Jack E. Froehlich, general manager of the newly created Applied Science Division of Space Electronics Corp., Glendale, Calif.

Dr. Maxwell Dauer, principal staff scientist, Plans & Programs Division, Aircraft Armaments, Inc., Cockeysville, Md.

Robert W. Lynch, chief engineer, McCormick Selph Associates Hollister, Calif.

Edward A. Fisher, manager-information systems, General Electric Co.'s Light Military Electronics Department, Utica, N. Y.

John W. Robinson, advertising and public relations manager, Kollsman Instrument Corp., Elmhurst, N. Y.

Dr. Heinz A. Gorges, director-advanced projects, Cook Technological Center Division, Morton Grove, Ill.

Dr. Philip H. Brunstetter, director-management development programs, Aerojet-General Corp., Sacramento, Calif.

Walter B. Brewer, Jr., assistant general manager, Engineering Division, Aerospace Corp., El Segundo, Calif.

William H. Foster manager, Advanced Technology Department, Advanced Electronics & Information Systems Division, Electro-Optical Systems, Inc., Pasadena, Calif., and **Keith L. Winsor,** manager, Advanced Electronics Department of the division.

William R. Bidermann, chief production engineer, Telecomputing Corp.'s Whittaker Gyro Division, Van Nuys, Calif.

Edward D. Barry, marketing services manager, Instrument and Equipment Group, Varian Associates, Palo Alto, Calif.

Roger L. Sisson, manager, Program Analysis-Technical Staff, Ford Motor Co.'s Aeronutronic Division, Newport Beach, Calif. Also: **Albert R. Conrad,** manager, Electro-mechanical Engineering, Computer Products Operations, Aeronutronic.

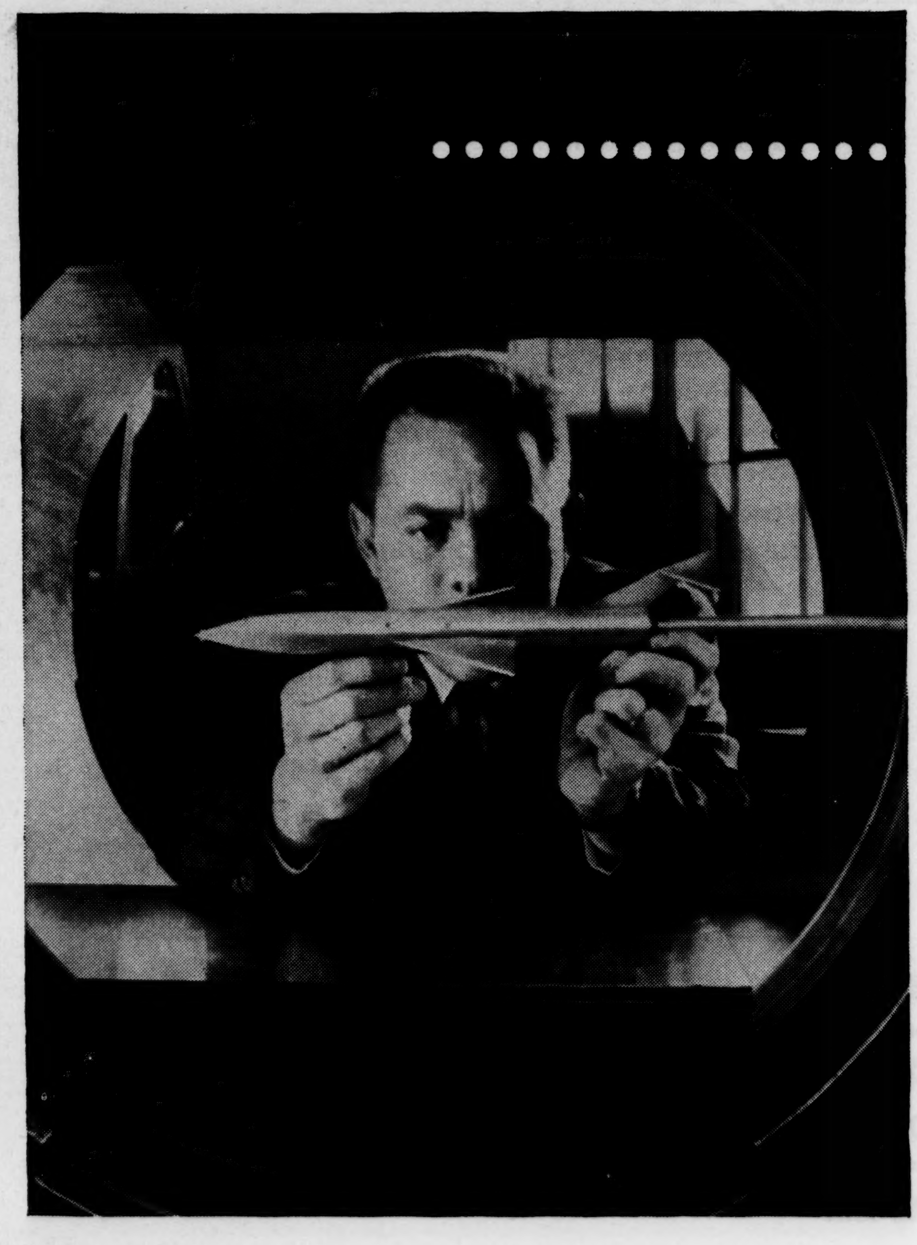
Richard D. Moroney, project engineer, G. T. Schjeldahl Co., Northfield, Minn.

George E. Holmes, in charge of SUBROC and Rocket Production Planning and Control, Goodyear Aircraft Corp.'s SUBROC Division, Akron, Ohio, and **Henry H. Nettling,** responsible for planning and processing functions.

David A. Beadling, manager, Fairchild Semiconductor Corp.'s Diode plant, San Rafael, Calif.

Dr. Louis A. Carapella has joined the Research Division of General Dynamics/Electronics, Rochester, N. Y.; he will be responsible for technical liaison within the division and with other divisions of General Dynamics.

Joseph F. McCaddon has been appointed to the Washington, D. C., office of Collins Radio Co.



Experimental

• AERODYNAMICIST

This is an ideal position for any engineer who likes to follow his project from start to finish. The man selected will take part in the building of test models, set up tunnel test-rigs, run the tests and supervise the taking of data. Final evaluation reports will go out to management and others over his signature.

Our investigations span the entire spectrum of flight. Currently these include studies on VTOL and STOL aircraft, advanced exhaust nozzles (turbojet, ramjet and rocket), inlets, airframe configurations and classified subjects. Facilities, which are among the largest and most extensive in this country, permit detailed investigations at speeds ranging from low subsonic to hypersonic.

Projects are not limited to products of United Aircraft Corporation. Many major aircraft manufacturers utilize these wind tunnels to supplement their own facilities.

If you prefer experimental aerodynamic investigations to more humdrum types of engineering, you will find this a real opportunity. The position offers challenging assignments, excellent job stability and above average fringe benefits.

Minimum Requirements: B.S. degree in Aeronautical or Mechanical Engineering and applicable experience.

Please send inquiry (including salary requirements) to
Mr. W. D. Walsh, *Personnel Department:*

RESEARCH LABORATORIES
UNITED AIRCRAFT CORPORATION
400 Main Street, East Hartford 8, Conn.

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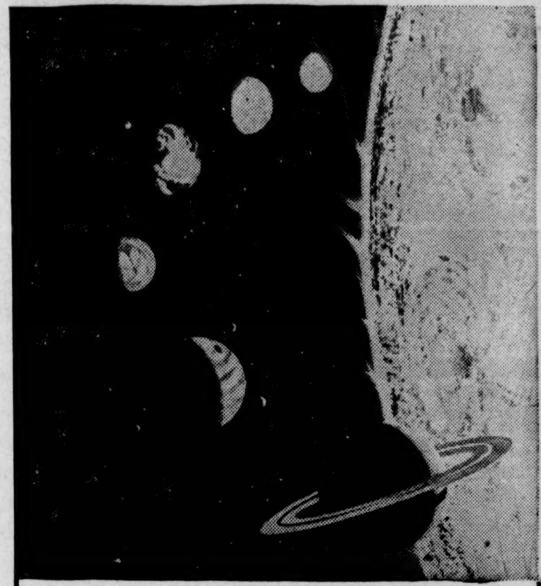

TRAJECTORY ANALYSTS

Space and Information Systems Division is rapidly extending its capabilities in the nation's developing space program, and is actively engaged in the development of the analytic tools necessary for studies in space kinematics.

Several key openings exist in our Space Systems Analysis Group for graduate mathematicians or physicists with experience in space mechanics and/or trajectory analysis. These positions involve orbit and interplanetary trajectory studies for space and satellite vehicles, including the effects of thrust variation, degrees of maneuverability, mission travel time, error analysis, and guidance requirements. Ultimate goals are the development of trajectory requirements for space exploration, intercept, observation and identification systems. Prime requisites are an innate curiosity about, and an intense interest in, any of the yet unexplored workings of the Universe.

For more information, write:

A. W. Cunningham, Manager
Employment Services
12214 Lakewood Blvd.
Downey, California

SPACE AND INFORMATION SYSTEMS DIVISION
North American Aviation

LETTERS

Booster Power

Your editorial of Feb. 20, "The Stern Chase in Space," gives an astute perspective of the importance booster power will be in this decade. It is clear that larger boost propulsion systems are required to put adequate tonnage into orbit and also at great distances from the earth. To extend your comments a step further, one can also present logic for having adequate programs to develop large electrical power systems for space vehicles. Although large boost power is required to put tonnage into orbit for complex missions, the effective utilization of tonnage payloads is dependent upon adequate electric power systems. As you know, all sophisticated satellites to date have been limited by available electric power systems.

In the planning of development programs for these power systems, it seems that we are in a situation similar to that of 1947 during the early days of the turbojet engine. Near-term firm power requirements are small, a few watts to a few kilowatts. This has resulted in specific development programs oriented to developing small wattage power systems. The remaining efforts in this country have been devoted to state-of-the-art R&D support. No truly large solar or nuclear space power systems are being developed through the operational stage. The usual comment given for the lack of support for large space power systems is that a firm vehicle requirement must exist to justify a development program which will result in a reliable flight system.

An examination of vehicle contractor studies, especially the SR studies conducted for the Air Force, indicates that the need for large electric power systems will come more quickly than present plans for developing these systems based on the justification of firm vehicle requirements. One can conceive of the need for solar power up to 150 kilowatts and nuclear electric power systems in the megawatt range for application by 1968. If a family of powerplants, both solar and nuclear, were to be developed to fill the range of a few kilowatts to a megawatt by 1968, I am sure the imagination of military planners and preliminary design personnel of the aerospace industry would find application for these power systems. If the present planning for development of space power systems is carried out, there can be a continuation of "The Stern Chase in Space" even though we eventually develop adequate booster capability. Instead of being limited by lack of boost power, we will be limited by the lack of adequate electrical power.

To overcome the inherent lag in tying power system development to firm vehicle requirements, it can be argued that large power systems should be developed separately as a family of "off the shelf" items. They would be developed as government-furnished equipment rather than as an integral part of a vehicle development program. This approach would result in a reduction in the time between the date a need is recognized to the time an operational power system is available. The time period between recognizing the need to that of justifying a firm requirement can be greatly reduced. There are many reasons that can be made for objecting to this approach, for instance, the fact that an "off the shelf" power system would not be optimum for a given vehicle. However, it seems that in our present situation, where time is of great importance, it is better to have a non-optimum vehicle with a non-optimum power system which is capable of performing required missions rather than having an optimum vehicle and power system which exists on paper.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Victor P. Kovacik
Chief, Preliminary Design Department
New Devices Laboratories
Tapco Group
Thompson Ramo Wooldridge, Inc.
Cleveland, Ohio

Colidar Article

Have just finished reading your article on the Colidar [coherent optical radar] (AW Feb. 27, p. 61). You are to be commended for a splendid job. The article was accurate, clear, and presented in an interesting fashion.

I sincerely appreciate your efforts and take this opportunity to thank you very much for an excellent job.

Rex C. Mack
Associate Manager
Ballistic Missile and Ballistic
Missile Defense Systems Laboratory
Hughes Aircraft Co.
Culver City, Calif.

Fourth Man

In your Feb. 20 issue of Aviation Week, you carried an article on p. 35 headlined "Kennedy Names Four Consultants on Organization of Government." Lo and behold, I could only count three after a close study of the article. And, what's more, the man you neglected to include was Sydney Stein, Jr., senior partner in Stein, Roe & Farnham, the firm that I work for (and where I read AW).

Mr. Stein would be the last one to bring this omission to your attention. However, I think the honor of the appointment is such that it would be unfortunate to let this error pass unnoticed. So, won't you complete this impressive foursome?

John R. Flanagan
Stein, Roe & Farnham
Chicago, Ill.

(The omission of Mr. Stein was accidental; the result of a production error.—Ed.)

Collision Avoidance

Your Jan. 30 issue (p. 124) carries a letter commenting on the analysis of an F-86L Bonanza collision as reported in the Dec. 19 issue (p. 95) of Aviation Week. In this letter the writer states that "The FAA should be made to understand that the 'see and be seen' philosophy is nonsense . . ."

The Applied Psychology Corp., as contractor for the FAA's research program to improve the means of avoiding collisions in VFR flight, finds much evidence contrary to this viewpoint.

While the incidence of collisions has been alarming, clearly the "near-miss" reports indicate that in many cases pilots have spotted proximate aircraft in time to make successful avoidance maneuvers. (An official government publication describes ". . . 425 incidents (38%) which were considered to be actual near midair collisions after investigation had been completed on the 1,112 near midair collisions reported during 1959.")

Certainly the increasing speed of aircraft and the constantly growing volume of air traffic do point up the importance of developing devices which will automatically prevent all collisions.

The considerable difficulties of such development are apparent, and at the present moment there is a lack of tangible evidence that such devices will be available in the immediate future.

As for the writer's assertion that ". . . much more control is needed for any altitude changes . . .," despite all efforts to expand and improve ground-control facilities, it appears that it will not soon be possible for these facilities to handle all of the more than 100,000 aircraft currently flying within the United States.

It is, therefore, essential to determine how pilots can be aided in the use of vision from the cockpit for avoidance of air collisions—for example, through improving conspicuity, devising information coding systems, providing optical devices, and delineating training programs. The research efforts of this company are proceeding toward that end.

Dr. Robert B. Sleight
President
Applied Psychology Corp.
Arlington, Va.

Lucky Day

On Jan. 31, 1961, a chimp was sent on a successful flight into space. This set up the possibility of sending an astronaut on a similar mission this spring.

It is my opinion that May 21 would be just the day for it, the anniversary of the greatest flight in history.

Maybe lady luck would bring another first to America as she did back in 1927—let's hope so.

Richard H. Walker
Danielson, Conn.